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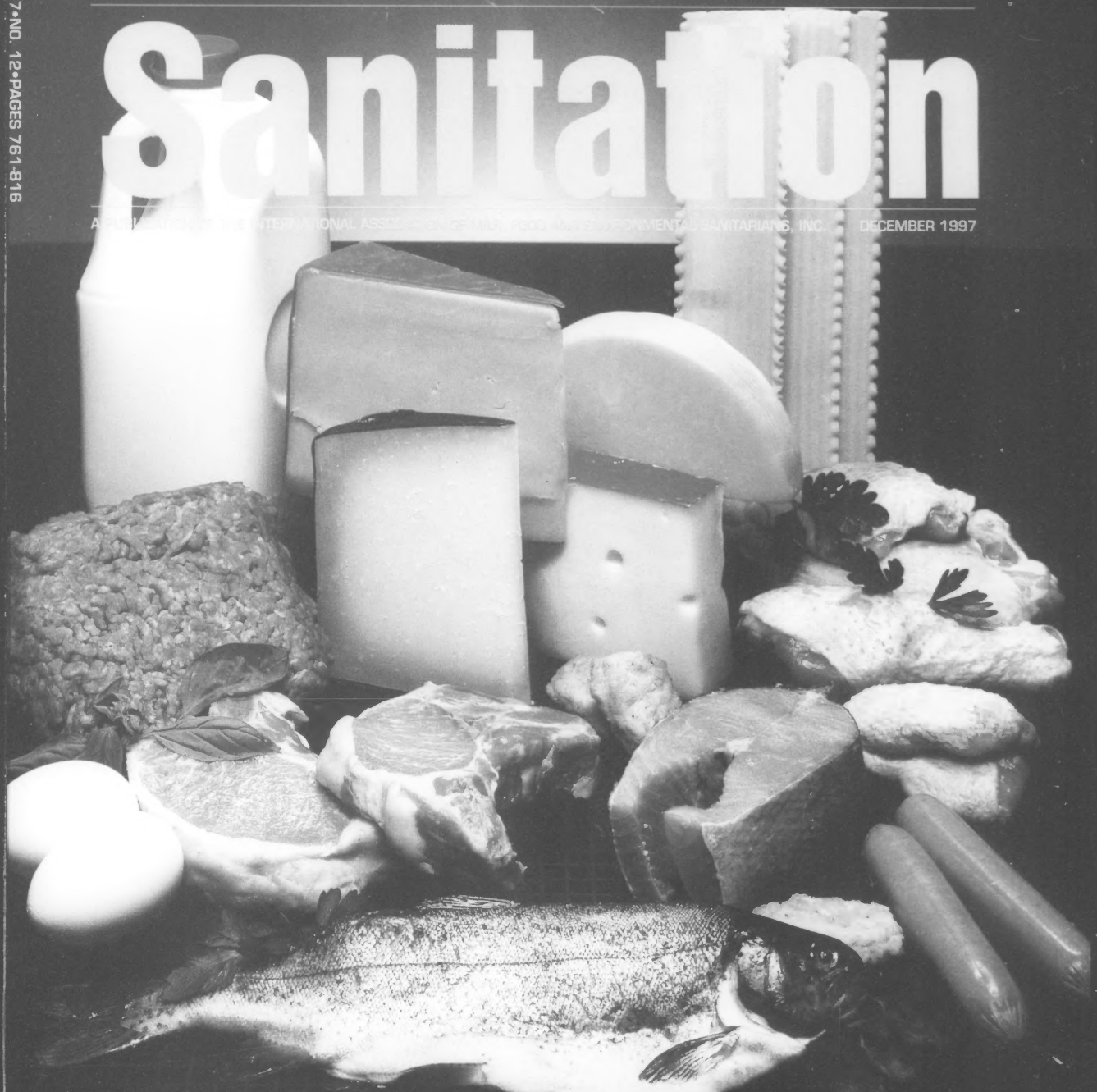
DAIRY, FOOD AND ENVIRONMENTAL

Sanitation

A PUBLICATION OF THE INTERNATIONAL ASSOCIATION FOR DAIRY, FOOD AND ENVIRONMENTAL SANITARIANS, INC. DECEMBER 1997



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DAIRY, FOOD AND ENVIRONMENTAL

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The award consists of a $3,000 honorarium and a plaque.

PURPOSE: To honor an individual (IAMFES member or nonmember) or a group or organization for preeminence in and outstanding contributions to the field of food safety.

ELIGIBILITY: Individuals or organizations may be from industry (including consulting), academia, or government. International nominations are encouraged. The nominee must have a minimum of 10 years of service in the food safety arena. Achievement may be measured by sustained contributions in research, education and information transfer over several years; the development of an innovative and effective strategy to promote a safer food supply; the solution to a significant food safety problem; etc. Nominations may not come from members of the selection panel, nor can an individual self-nominate. An individual can nominate the organization for which the individual works.

To request nomination forms, contact:

IAMFES
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Des Moines, IA 50322-2863

By telephone: 800-369-6337; 515-276-3344
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Nominations deadline is February 20, 1998. Nomination forms must be received at the IAMFES office by this date.

COMMENTS

FROM YOUR PRESIDENT

By GALE PRINCE
IAMFES President

"Fight BAC"

Hats off to the Partnership for Food Safety Education on the announcement of a National Food Safety Education Program for Consumers. The trademark character of "Fight BAC" is very eye-catching and is destined to become a common household icon associated with food safety. This is a campaign designed not only to educate consumers on the problems presented by foodborne illness, but also to motivate them to take basic sanitation and food handling measures that will reduce their risk of falling victim to them. The campaign includes public service announcements on television that will show consumers how to use four key elements (clean, separate, cook, and chill) necessary to prevent foodborne illness in the home. The animated character used in the campaign has received high marks in focus group evaluations as a communications tool. The web address for the campaign is www.fightbac.org; visit it and see for yourself.

The Partnership for Food Safety Education is aimed at establishing a focus for consumer food safety information, sharing expertise, and pooling resources to provide a state-of-the-art educational program. The group is made up of representatives from nine trade associations, the USDA, FDA, CDC, the U.S. Department of Education, and various consumer groups. Plans call for this to be an ongoing program as part of U.S. President Bill Clinton's Food Safety Initiative, a national initiative aimed at dealing with food safety education.

I have also had the privilege of representing IAMFES on the Food Safety Training and Education Alliance, which has been formed by the FDA to deal with the educational concerns outlined in President Clinton's Food Safety Initiative. The Alliance is composed of representatives from the FDA, USDA, CDC, and professional associations involved in food service, food retail, vending, and institutional feeding. The Alliance is presently working to identify food safety training materials currently in use. Once this list is obtained, the group will make recommendations on educational material needs in food safety for the identified industries and regulatory personnel. Our last meeting was held at the USDA National Agricultural Library. Food safety information and training materials are being collected and catalogued in the Library as part of continued efforts to update the nation's resources.

In the past few weeks, members of the Executive Board have taken part in several IAMFES affiliate meetings. Representatives of the Board have spoken at affiliate meetings in Washington, Illinois, Kansas, Wisconsin, Ontario, and Ohio. Each enjoyed meeting with members of the local affiliate. We have been a part of some excellent meetings with good attendance.

Another hats off to IAMFES employee Lisa Backer on her completion of the 26.2 mile Toronto International Marathon on October 19, 1997. Lisa ran the race as part of her dedication to raising $2,500 for the Leukemia Society in its battle against leukemia. Leukemia is the leading disease causing death in children. It is certainly nice to have such a caring person as part of the IAMFES team.

I wish each of you a joyful holiday season with your loved ones and hope you have a rewarding New Year!

NASHVILLE

Start Planning Now!

85th IAMFES
Annual Meeting
August 16–19, 1998
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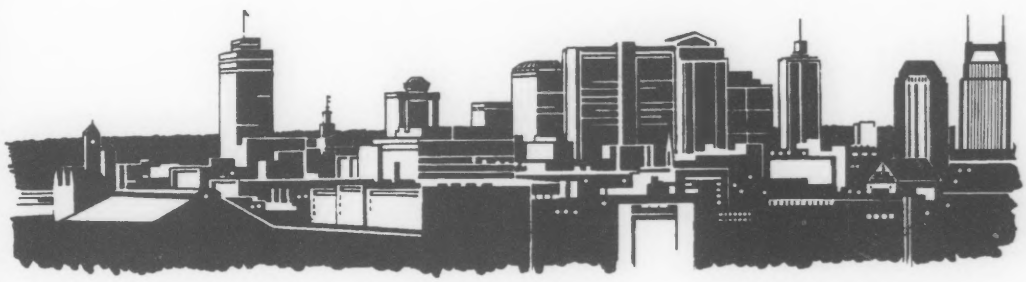

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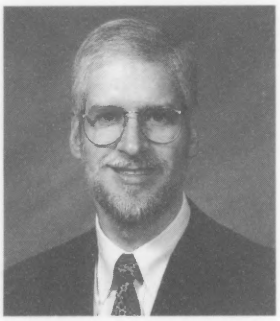
COMMENTARY

FROM THE EXECUTIVE DIRECTOR



By DAVID W. THARP
IAMFES Executive Director

"The progress made during 1997 is a result of many IAMFES members"

Now that the year is near its end, this is a good time to look back over the past 12 months and recount our progress. Recall that I was appointed as Executive Director in January of 1997. Many projects were already underway such as the Program Advisory Meeting (mid-January) and the Executive Board meeting that followed. Planning for the IAMFES Annual Meeting in Orlando was progressing well.

At the April Board meeting, we set aside time to conduct a planning session with staff and Board participation. During this time, priorities and goals were set that helped to direct our efforts and provided guidance for the future. It became evident that we needed to expand our membership base and extend awareness of our journals to potential subscribers. It was decided our current system of databases would not be capable of performing in the manner required and approval to install a new database system was received. That installation took place late in September and we are currently adapting to the new system. Beginning in 1998, we will be able to use information generated on nonmembers to begin marketing efforts to gain their membership.

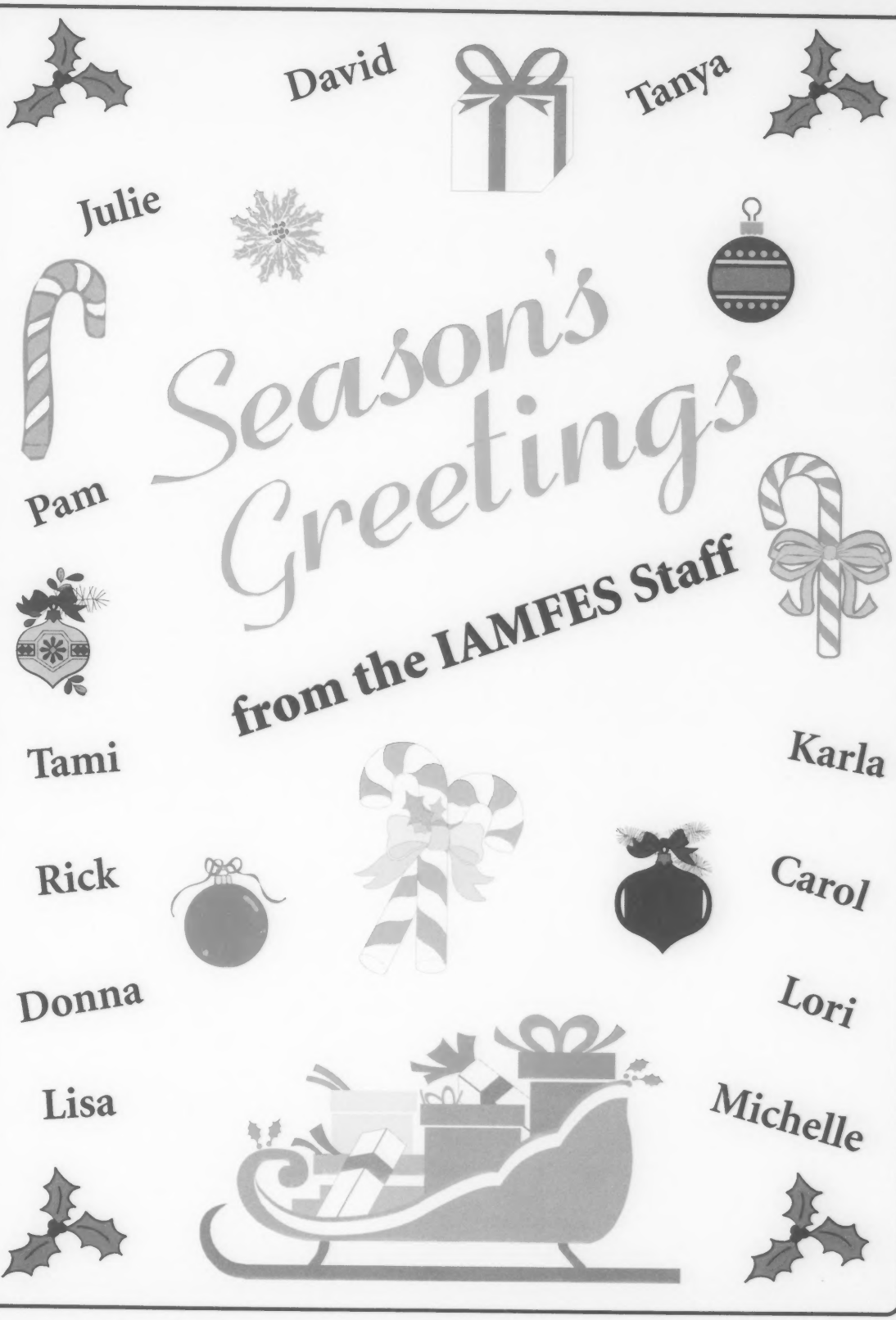
The Annual Meeting last July saw attendance from around the globe of over 1,000 for the first time in our history. Attendees were able to take advantage of superb educational opportunities and networking. Our Florida Affiliate put forth great efforts for which we are truly grateful. We issued a charter to a new Korean Affiliate during the Annual Meeting and introduced our new brochure "Before Disaster Strikes...A Guide to Food Safety in the Home" written by our Food Sanitation Professional Development Group.

Just recently, we opened our Web site at www.iamfes.org and now have information about our association, journals, Annual Meeting, and publications available around the world at anytime, day or night! We were present at the World Wide Food Expo in Chicago, Illinois at the end of October and enjoyed seeing many members and potential members. Remember, too, that your mention of IAMFES to colleagues is the best marketing tool we have for developing new members!

The financial picture improved during our Fiscal Year ending August 31, 1997. A summary report is presented on page 812. Our results were ahead of our budget and we improved our general fund balance during the year. We are still operating with a "negative" general fund balance, but hope to complete the turnaround by August 1999. Having a negative fund balance means that since our inception (1911), we have overspent our revenues in order to operate the association. Rest assured that we have taken all precautions to correct this and IAMFES' financial health continues to improve rapidly!

I want you to know that the progress made during 1997 is a result of many IAMFES members, including the Executive Board. I also want to take time to recognize the efforts of the IAMFES staff. Their many hours of dedication to the Association are paying big dividends for you, our members. Thanks to Lisa Backer, Donna Bahun, Lori Beason, Julie Cattanach, Karla Jordan, Rick McAtee, Carol Mouchka, Tami Schafroth, Tanya Smith, Michelle Sproul, and Pam Wanninger. Each of you have done a great job!

Now it is time to end this review with ***our sincere wishes for the happiest of holiday seasons to all and our hopes for a healthy and prosperous year in 1998.***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Dairy, Food and Environmental Sanitation, Vol. 17, No. 12, Pages 774-780

Potential Uses of Microbiological Testing in Cheese Plant HACCP and Quality Assurance Systems

Steven Ingham,[1] Ann Larson,[3] Marianne Smukowski,[2] Kristen Houck,[2] Eric Johnson,[3] Mark Johnson,[2] and Rusty Bishop[1, 2]

SUMMARY

Raw milk, in-process, and one-month-old product samples were obtained over 18 months from three cheese plants and tested for presence of *Listeria monocytogenes* and *Salmonella* spp. and for numbers of *Bacillus cereus*, presumptive *Staphylococcus aureus*, coliforms, enterococci, presumptive *Lactobacillus*, and yeasts and molds. Combined data from the three plants showed that 9.5, 47.4 and 77.9% of raw milk samples contained *Salmonella* spp., *L. monocytogenes*, and presumptive *S. aureus*, respectively, that were eliminated by pasteurization. Presumptive *S. aureus* was found in some in-process samples. Testing for *S. aureus* may be useful for verifying the effectiveness of prerequisite whey handling and worker hygiene programs. Whey, fines, chill water, and brine were potentially important sources of microbial contaminants, particularly presumptive *S. aureus* and indicator organisms. Enterococci were present more often than coliforms in one-month-old Cheddar-type or Mozzarella cheeses and may be a more useful indicator group for finished product testing, provided *Enterococcus* spp. are not used as starters or adjuncts. Fresh-type cheeses, such as queso blanco, were more likely to contain coliforms than enterococci after one month storage. For these cheeses, coliform testing may be a more useful way of verifying sanitation. Quantitation of *S. aureus* and either coliforms or enterococci can be useful in verifying the effectiveness of HACCP and prerequisite programs at cheese plants.

INTRODUCTION

It is widely accepted that microbiological testing is an important verification activity within a Hazard Analysis Critical Control Point (HACCP) food safety system. The goal of verification activities is to confirm that the HACCP system effectively ensures food safety and, if it does not, to alert HACCP team members to revise the HACCP plan or take other corrective actions. Because verification activities are done periodically and may be done for product that has already been shipped, the time required for microbiological testing is not a deterrent to its use. Monitoring of Critical Control Points, on the other hand, must indicate compliance or the product involved will be held pending corrective action. An ideal monitoring method would be one that provides instantaneous results and 100% product coverage. Therefore, microbiological testing is generally regarded as an inappropriate monitoring activity within a HACCP system because of excessive time required to perform the analyses.

In addition to its function for HACCP verification, microbiological testing can also be useful in verifying that prerequisite programs such as

TABLE 1. Microbiological sampling sites from cheese plants A, B, and C

Plant A	Number of samples collected
Starter	29
Raw milk	28
Curds + whey from transfer line	12
Whey storage in separator room	17
Cold whey storage	31
Hot whey storage	22
Cold condensed whey storage	27
Fines	28
Whey cream	31
One-month-old cheese	29
Plant B	
Raw milk	32
Curds + whey after cutting	31
Whey	59
Brine	12
Freshly packaged cheese	8
One-month-old cheese	35
Plant C	
Starter	40
Raw milk	41
Whey after cutting	39
Fines	40
Whey in finishing vat	42
Curd from mixer	21
Chill water	29
Brine	21
Curd from blocks or molds	21
Drippings from blocks or molds	21
One-month-old cheese	39

worker hygiene, whey handling, cleaning, and sanitizing are effective and that desired microbiological quality standards have been met in the finished products. For example, microbiological test results may indicate routes by which pathogenic or non-pathogenic contamination of cheese occurs. Results may also signal that a lapse in sanitation or worker hygiene has occurred. Therefore, microbiological analyses done in a cheese plant may include (1) testing for pathogenic bacteria that were identified as significant hazards during a hazard analysis, (2) testing for indicator microorganisms whose presence or numbers may be correlated with the presence of pathogens, and (3) testing for indicator microorganisms whose presence or numbers reflect poor control of a plant's prerequisite sanitation programs.

A wide variety of cheeses are made commercially in the USA. Even for a particular cheese variety, plants may differ markedly in the processing steps utilized. In the present study, comprehensive microbiological testing was done in three very different cheese processing plants. The goal of the project was to identify sampling sites and microbiological analyses that would be useful to cheesemakers for verification of HACCP, HACCP prerequisite (worker hygiene, sanitation) and quality assurance systems performance.

MATERIALS AND METHODS

Each of three cheese plants was visited approximately twice quarterly over an 18-month period. The three plants involved in the project represented "large," "medium," and "small" plants in the United States. The types of cheeses made in the three plants included Cheddar and related cheeses, Mozzarella, Muenster, and various fresh cheeses such as queso blanco. At each sampling visit, samples were taken from multiple lots of cheese. Samples were collected at steps from raw milk through one-month-old finished cheeses. For milk, starter, combined curds and whey, whey, and whey cream, the sample size was approximately 100 g. For curds, fines, and finished products, the sample size was at least 10 g. Samples were obtained aseptically, either by use of a syringe through an in-line grommet, by use of a sanitized dipper, by bagging flowing product in a sterile Whirl-Pak bag (Nasco, Ft. Atkinson, WI), or by cutting with a cleaned and sanitized knife. Sampling sites for each plant are listed in Table 1.

All samples were tested for microorganisms whose presence or numbers might indicate safety or sanitary condition. Analyses were done in two cooperating laboratories at the University of Wisconsin-Madison. Analyses for coliforms, enterococci, presumptive lactobacilli, and yeasts and molds were done in one labora-

TABLE 2. Prevalence of *Salmonella* spp., *Listeria monocytogenes*, *Staphylococcus aureus*, and *Bacillus cereus* in raw milk supplied to three Wisconsin cheese plants

Plant	Number of samples	Frequency (%) of *Salmonella*[1]	*L. monocytogenes*[1]	*S. aureus*[2]	*B. cereus*[2]
A	22	18.2	77.3	68.2	4.5
B	32	6.3	56.3	78.1	0
C	41	7.3	24.4	82.9	9.7

[1]present in 25 g or ml

TABLE 3. Concentrations of *Staphylococcus aureus* in raw milk supplied to three Wisconsin cheese plants

Plant	Number of samples	Frequency (%) $0 - 10^2$	Between given CFU/ml $10^2 - 10^3$	Values $> 10^3$
A	22	81.8	4.5	13.7
B	32	56.3	43.7	0
C	41	60.9	31.7	7.3

tory and analyses for presumptive *Staphylococcus aureus*, *Salmonella* spp., *Listeria monocytogenes*, and *Bacillus cereus* were done in the second laboratory. In the first laboratory, the initial and subsequent dilutions of milk and whey samples were made in 0.1% (w/v) proteose peptone. For samples of curd and whey mixtures, fines, and cheese, the initial dilution was in 2.0% (w/v) sodium citrate solution warmed to 45°C and subsequent dilutions were made in 0.1% proteose peptone. The initial dilution of each sample of curd and whey mixtures, fines, and cheese was homogenized using a blade-type blender.

Analyses for the pathogenic bacteria previously listed were done in the second laboratory for (1) the majority of raw milk and whey samples from plant A, (2) all samples from plant B, and (3) all but the one-month-old cheese samples from plant C. In this laboratory all dilutions were made in 67 mM sodium phosphate buffer (pH 6.6), with the initial dilution of solid samples homogenized using a Stomacher Lab Blender (Tekmar Model 400, Fisher Scientific, Itasca, IL). To enumerate presumptive *Staphylococcus aureus*, samples were spread-plated on Baird-Parker agar (BBL, Cockeysville, MD) with added egg yolk-tellurite enrichment (Sigma, St. Louis, MO) and incubated for 2 days at 37°C. To reduce the detection threshold for this pathogen in solid samples, 0.2 ml of an initial 1:2 dilution was spread-plated on each of two plates. Colonies with typical *S. aureus* morphology were counted. The presence of *Salmonella* spp. in 25.0 g samples was determined by enrichment according to the procedure in the Food and Drug Administration's Bacteriological Analytical Manual *(2)* and biochemical confirmation on Triple Sugar Iron agar (Difco, Detroit, MI) and Lysine Iron agar (Difco) slants. A qualitative analysis for *Listeria monocytogenes* in 25.0 g samples was done by enrichment in Listeria Enrichment broth (Difco) for 2 d at 30°C, differential plating on LPM agar (Difco) and Oxford agar (Oxoid, Ogdensburg, NY), and confirmation of typical *L. monocytogenes* colonies by the Christie-Atkins-Munch-Peterson (CAMP) test on sheep blood agar *(2)*. Enumerations of *Bacillus cereus* were done on all samples by spread-plating on Mannitol-Egg Yolk-Polymyxin agar *(2)* and aerobic incubation for 24 h at 37°C. To reduce the *B. cereus* detection threshold, an initial 1:2 dilution of solid samples was prepared and 0.2 ml of this dilution was spread-plated on each of two plates.

Enterococci and coliforms were enumerated using citrate azide agar and violet red bile agar, respectively *(4)*, and presumptive lactobacilli by pour-plating on Rogosa SL agar (Difco) and incubating anaerobically for 48 h at 37°C. Yeast and mold counts were obtained by spread-plating on acidified potato dextrose agar (Difco; 10% tartaric acid added to final medium pH of 3.5) and incubating for 5 days at 22°C.

RESULTS

The raw milk supplied to the three cheese plants was often contaminated with pathogenic bacteria (Table 2). *S. aureus* and *L. monocytogenes* were the most frequently present pathogens. *Salmonella* spp. and *B. cereus* were present much less frequently. When *S. aureus* was present in raw milk, its concentration varied (Table 3). Although 78.1% of plant B raw milk samples were contaminated with *S. aureus*, no samples from plant B contained $> 1.0 \times 10^3$ CFU/ml (Table 2). The concentration of *S. aureus* in raw milk from plants A and C was occasionally $> 1.0 \times 10^3$ CFU/ml, indicating that either contamination was greater or raw milk holding temperatures were more conducive to growth. The four raw milk samples from plant C that contained *B. cereus* had very low concentrations of this pathogen ($1.0 \times 10^1 - 9.0 \times 10^1$ CFU/ml) as did the one raw milk sample from plant A that contained *B. cereus* (7.0×10^1 CFU/ml). Pasteurization eliminated all pathogens from milk except for *B. cereus* endospores (data not shown). Nearly all raw milk samples contained coliform bacteria

TABLE 4. Frequency (% of samples) of indicator bacteria present at specified concentrations in raw milk supplied to three Wisconsin cheese plants. Concentrations are in CFU/g

Plant	n	Coliforms $\geq 10^{1}$ [a]	Enterococci $\geq 10^{1}$	Presumptive lactobacilli $\geq 10^{3}$	Yeasts & molds $\geq 10^{2}$
A	22	90.9	4.5	59.1	53.6
B	32	96.9	37.5	21.9	56.3
C	41	97.6	9.8	36.6	36.6

[a] CFU per g or ml

TABLE 5. Percentage of in-process and product samples from Plant A containing pathogenic bacteria and indicator microorganisms. Abbreviations and criteria for each organism are listed below

Site	B.c.	L.m.	S.a.	Salm.	Colif.	Ent.	Lb.	YM
Starter	0*	NT	NT	NT	3.4	0	0	0
Curds + whey from transfer line	0	NT	NT	NT	0	33.3	0	0
Whey storage in separator room	4.3	0	25.0	0	86.4	0	63.6	9.1
Cold whey storage	14.3	0	3.6	0	85.2	0	29.6	11.1
Hot whey storage	4.5	0	0	0	27.3	0	9.1	13.6
Cold condensed whey storage	14.8	0	9.5	0	37.0	0	3.7	3.7
Fines	3.6	NT	NT	NT	96.4	25.0	85.7	46.4
Whey cream	22.6	NT	NT	NT	87.1	67.7	61.3	25.8
One-month-old cheese	0	NT	NT	NT	3.4	55.2	3.4	6.9

* n= 20
NT = not tested
B. cereus (B.c.): percent of samples containing $\geq 5.0 \times 10^{0}$ CFU per ml or g.
L. monocytogenes (L.m.): percent of 25 g samples containing the organism.
S. aureus (S.a.): percent of samples containing $\geq 5.0 \times 10^{0}$ CFU per ml or g.
Salmonella spp. (Salm.): percent of 25 g samples containing the organism.
Coliforms (Colif.): percent of samples containing $\geq 1.0 \times 10^{1}$ CFU per ml or g.
Enterococci (Ent.): percent of samples containing $\geq 1.0 \times 10^{1}$ CFU per ml or g.
Presumptive lactobacilli (Lb.): percent of samples containing $\geq 1.0 \times 10^{3}$ CFU per ml or g.
Yeasts and molds (YM): percent of samples containing $\geq 1.0 \times 10^{2}$ CFU per ml or g.

at concentrations of $\geq 1.0 \times 10^{1}$ CFU/ml (Table 4). The percentage of raw milk samples that contained enterococci at concentrations of $\geq 1.0 \times 10^{1}$ CFU/ml varied, but was always much lower than for coliforms. In addition to being found in feces, coliform bacteria are present in vegetative matter, and thus the high percentage of raw milk samples contaminated with coliforms does not necessarily indicate fecal contamination. Enumeration of *Escherichia coli* would perhaps be more useful than coliforms for indicating fecal contamination, but the dairy industry has traditionally used coliform counts as an index of overall sanitary conditions. The genus *Enterococcus* has been studied as an alternative to coliforms for indicating fecal contamination or overall sanitary conditions. The main advantage of using this genus instead of the coliform group is that the enterococci are much more cold-tolerant than coliforms and would be more likely than coliforms to survive during refrigerated storage of samples to the same extent as any pathogens present. Among the enterococci, *Enterococcus faecalis* and *E. faecium* are known to be primarily of fecal origin. *Enterococcus hirae*, *E. durans*, and *E. saccharolyticum* have been associated with cattle *(3)*. Other *Enterococcus* species have been isolated from the feces of humans, swine, or birds. However, some of the enterococci are also found on vegetation or in soil. Therefore, the presence of enterococci in dairy products does not necessarily indicate that fecal contamination has occurred. In addition, some *Enterococcus* spp. reportedly are used as starter cultures. Obviously, concentrations of enterococci could not be used as an indication of sanitation in this situation.

Between 21.9% and 59.1% of raw milk samples contained presumptive lactobacilli at concentrations of $\geq 1.0 \times 10^{3}$ CFU/ml and between 36.6% and 56.3% of raw milk samples contained yeasts and molds at concentrations of $\geq 1.0 \times 10^{2}$ CFU/ml. Lactobacilli are normally associated with raw milk and their presence in high numbers is probably of limited value as an indica-

TABLE 6. Percentage of in-process and product samples from plant B containing pathogenic bacteria and indicator microorganisms. Abbreviations and criteria for each organism are listed below

Site	B.c.	L.m.	S.a.	Salm.	Colif.	Ent.	Lb.	YM
Curds + whey after cutting	9.7	0	3.2	0	9.7	29.0	9.7	6.4
Whey	10.2	0	23.7	0	23.7	1.7	11.9	3.4
Brine	0	0	8.3	0	0	0	16.7	0
Freshly packaged cheese	50.0*	0	0	0	100**	37.5*	0	0
One-month-old cheese	2.9	0	25.7	0	34.3	5.7	5.7	10.5

* n = 8

** n = 4

B. cereus (B.c.): percent of samples containing $\geq 5.0 \times 10^0$ CFU per ml or g.

L. monocytogenes (L.m.): percent of 25 g samples containing the organism.

S. aureus (S.a.): percent of samples containing $\geq 5.0 \times 10^0$ CFU per ml or g.

Salmonella spp. (Salm.): percent of 25 g samples containing the organism.

Coliforms (Colif.): percent of samples containing $\geq 1.0 \times 10^1$ CFU per ml or g.

Enterococci (Ent.): percent of samples containing $\geq 1.0 \times 10^1$ CFU per ml or g.

Presumptive lactobacilli (Lb.): percent of samples containing $\geq 1.0 \times 10^3$ CFU per ml or g.

Yeasts and molds (YM): percent of samples containing $\geq 1.0 \times 10^2$ CFU per ml or g.

tor of raw milk quality. Yeasts and molds are commonly associated with the dairy farm environment and their presence in raw milk may indicate environmental contamination.

Because each cheese plant varied considerably in size, layout, and types of cheeses produced, the microbiological testing results will be discussed for each plant in turn (Tables 5 to 7). Analyses for *L. monocytogenes, Salmonella* spp. and presumptive *S. aureus* were performed on whey samples from plant A. None of these samples contained detectable *L. monocytogenes* or *Salmonella* spp. Presumptive *S. aureus* was detected in 25% of whey samples taken from storage in the separator room. Concentrations of *S. aureus* in these positive samples were all $\geq 1.0 \times 10^3$ CFU/ml. Of the remaining whey sampling sites, only three samples contained presumptive *S. aureus*; none of the three samples had concentrations $\geq 1.0 \times 10^2$ CFU/ml. *S. aureus* is usually considered hazardous in foods only when present at the high concentrations associated with enterotoxin production. Low numbers of *S. aureus* are likely to increase to dangerous levels only if the product is temperature abused and if there is little microbial competition. The whey may have been contaminated with *S. aureus* by plant personnel; an estimated 10 to 40% of humans carry this pathogen in the nose *(5)*. Presence of *S. aureus* in curds or finished cheese may be used to indicate either poor personnel hygiene practices or sloppy handling of whey. *B. cereus* was detected at low concentrations (5.0×10^0 to 6.2×10^2 CFU/ml) in whey, whey cream, and fines samples in plant A. Since *B. cereus* was present in low concentrations in a small proportion of raw milk samples at plant A and pasteurization does not destroy *B. cereus* endospores *(1)*, its presence in whey was not surprising.

Coliforms ($\geq 1.0 \times 10^1$ CFU/ml or g) were frequently detected in whey, whey cream, and fines samples from plant A. Enterococci ($\geq 1.0 \times 10^1$ CFU/ml or g) were not detected in whey samples but were present in one-fourth of fines samples and over two-thirds of whey cream samples. Yeasts and molds ($\geq 1.0 \times 10^2$ CFU/ml or g) were present in just over 10% of whey samples, in over 40% of fines samples, and in 25.8% of the whey cream samples. Presumptive lactobacilli were present in concentrations $\geq 1.0 \times 10^3$ CFU/ml or g in the vast majority of fines and whey cream samples. Although not indicators per se, these organisms may affect cheese quality. The prevalence of coliform bacteria, yeasts and molds, and presumptive lactobacilli in whey, fines, and whey cream samples strongly suggests that these byproducts can serve as sources of microbial contaminants in cheesemaking. However, enterococci were the only indicator organisms found in more than 10% of the one-month- old cheese samples. This finding probably reflects the fact that the enterococci are more cold-tolerant than coliforms. The microbiological testing results from plant A suggest that: (a) whey cream and fines, if used in cheesemaking, can serve as a contamination route for indicator organisms and *B. cereus* endospores, (b) testing curd or cheese samples for *S. aureus* may be useful for verifying proper whey handling and worker hygiene practices during cheesemaking, and (c) enterococci appear to be the indicator organisms most likely to survive in the one-month-old cheese and thus may be the best indication of in-process sanitation.

Production of cheese in plant B (Table 6) was less automated than in plants A and C, and thus contamination of cheese with *S. aureus* via worker handling would be expected to occur more frequently in plant B than in plants A and C. Whey from plant B was more frequently contaminated with this pathogen than wheys from plants A and C. Although no freshly packaged cheeses contained detectable levels of *S. aureus*, 25.7% of the one-month-old cheeses contained low (1.0×10^1 to 1.6×10^2 CFU g) concentrations of *S. aureus*. One sample of curds and whey sampled

TABLE 7. Percentage of in-process and product samples from plant C containing pathogenic bacteria and indicator microorganisms. Abbreviations and criteria for each organism are listed below

Site	B.c.	L.m.	S.a.	Salm.	Colif.	Ent.	Lb.	YM
Starter	2.5	0	7.5	0	0	0	0	0
Whey after cutting	2.4	0	9.5	0	0	7.1	0*	0
Fines	0	0	12.8	0	23.1	5.1	0*	0
Whey from finishing vat	2.4	0	4.8	0	4.8	2.4	0*	0
Curd from mixer	4.8	0	14.3	0	0	28.6	66.7	0
Chill water	26.7	0	30.0	0	26.7	0	30.0	13.3
Brine	28.6	0	9.5	0	0	0	0	14.3
Curds from molds or blocks*	0	0	9.5	0	9.5	23.8	14.3	0
Drippings from molds or blocks*	0	0	28.6	0	61.9	0	38.1	28.6
One-month-old cheese	0	NT	NT	NT	7.1	33.3	0*	0

* Only cheeses made without added lactobacilli
NT = not tested
B. cereus (B.c.): percent of samples containing $\geq 5.0 \times 10^0$ CFU per ml or g.
L. monocytogenes (L.m.): percent of 25 g samples containing the organism.
S. aureus (S.a.): percent of samples containing $\geq 5.0 \times 10^0$ CFU per ml or g.
Salmonella spp. (Salm.): percent of 25 g samples containing the organism.
Coliforms (Colif.): percent of samples containing $\geq 1.0 \times 10^1$ CFU per ml or g.
Enterococci (Ent.): percent of samples containing $\geq 1.0 \times 10^1$ CFU per ml or g.
Presumptive lactobacilli (Lb.): percent of samples containing $\geq 1.0 \times 10^3$ CFU per ml or g.
Yeasts and Molds (YM): percent of samples containing $\geq 1.0 \times 10^2$ CFU per ml or g.

after cutting also contained *S. aureus* at a low concentration (1.0×10^1 CFU/g). Plant B samples were predominantly from batches of fresh-type cheese, such as queso blanco. Plants A and C did not make fresh-type cheeses. The amount of manual labor involved in cheesemaking, along with the likely absence of competing starter culture bacteria (starter cultures were not used in 80% of the batches sampled), demonstrates the importance of verifying that proper sanitary practices are followed at plant B. *Bacillus cereus* was infrequently ($\leq$ 10%) present in samples, with the exception of the freshly packaged cheeses. Of the eight freshly packaged cheeses tested, half contained low concentrations of this pathogen. However, only 2.9% of one-month-old cheeses from plant B contained *B. cereus*. No in-process or cheese samples from plant B contained detectable levels of *L. monocytogenes* or *Salmonella* spp.

Indicator organisms were relatively infrequent in curd and whey samples taken after cutting in plant B. As in plant A, results suggested that whey was a potential source of contamination with indicator organisms, although the percentages of samples containing $\geq 1.0 \times 10^1$ CFU/ml of coliforms, $\geq 1.0 \times 10^2$ CFU/ml yeasts and molds, or $\geq 1.0 \times 10^3$ CFU/ml presumptive lactobacilli were lower than for whey samples from plant A. The brine samples tested did not contain coliforms or enterococci, but one sample did contain a low concentration (1.5×10^1 CFU/ml) of *S. aureus*. Presumptive lactobacilli at concentrations of $\geq 1.0 \times 10^3$ CFU/g were found in one-sixth of the brine samples. The relative scarcity of presumptive lactobacilli probably occurred because starter cultures containing *Lactobacillus* were not used in the plant. Coliforms were the indicator organisms most likely to be present in one-month-old cheese samples. Yeasts and molds at concentrations of $\geq 1.0 \times 10^2$ CFU/g or ml were detected only in 3.4 and 10.5% of whey and one-month-old cheese samples, respectively. These results show that a rigorous sanitation and hygiene training program instituted by plant B were effective in reducing microbial indices to levels comparable to those at plants A and C. The results also suggest that (a) testing of whey, brine, and finished product for *S. aureus* may be useful to plant B for verifying the maintenance of proper whey handling and worker hygiene during cheesemaking, and (b) coliform testing of finished product may provide verification of proper whey handling and plant sanitation practices.

Listeria monocytogenes and *Salmonella* spp. were not detected in any in-process sample at plant C (Table 7). However, *S. aureus*, usually at concentrations of $\leq 1.0 \times 10^2$ CFU/ml or g, was found in 4.8% to 30% of samples taken from in-process sites. This pathogen was most commonly found in chill water, drippings from molds or blocks of cheese, curd taken from the mixer, and fines. *B. cereus* was present in approximately one-fourth of the brine and chill water samples, at concentrations of $5.0 \times 10^0 - 1.7 \times 10^3$ CFU/ml. Other samples containing *B. cereus* were the starter, whey obtained after curd cutting, whey from the finishing vat, and curd from the mixer.

Coliforms ($\geq 1.0 \times 10^1$ CFU/g or ml) were detected in 23.1% of fines samples, 26.7% of chill water samples, and 61.9% of sampled drippings from molds or blocks. However, only 7.1% of one-month-old cheeses contained coliforms at concentrations $\geq 1.0 \times 10^1$ CFU/g. Enterococci at concentrations of $\geq 1.0 \times 10^1$ CFU/g or ml were not detected in the chill water but were detected in over one-fourth of curd samples taken from the mixer. The latter samples did not contain coliforms at concentrations of $\geq 1.0 \times 10^1$ CFU/g. This difference may reflect the fact that Gram-positive bacteria, including the enterococci, are generally more heat-resistant than Gram-negative bacteria and could presumably survive heating during mixing of the curds. Enterococci at concentrations of $\geq 1.0 \times 10^1$ CFU/g were detected in 33.3% of the one-month-old cheeses, but coliforms at these concentrations were present only in 7.1% of these samples. Presumptive *Lactobacillus* spp. should not be used as an indicator group for sanitation when *Lactobacillus* spp. are used in cheese manufacture. Presumptive lactobacilli at concentrations of $\geq 1.0 \times 10^3$ CFU/g or ml were found in some curd and drippings samples from molds or blocks, but were not found in one-month-old samples of cheese made without added lactobacilli. Yeasts and molds at concentrations of $\geq 1.0 \times 10^2$ CFU/g or ml were detected only in chill water and brine, and in drippings from molds or blocks. The results of testing in plant C suggest that (a) analysis for presumptive *S. aureus* would be useful for verifying worker hygienic practices, (b) chill water and brine are potential sources of bacterial contamination, and their microbiological quality and safety should be verified by testing for presumptive *S. aureus* (chill water and brine) and coliforms (chill water only), and (c) enterococci are probably the most useful indicator organisms for verification of stored cheese quality.

CONCLUSION

Overall, the results show that (a) raw milk received at cheese plants is often contaminated with pathogenic bacteria and should be heated to kill these organisms, (b) *S. aureus* is a frequent in-process pathogenic contaminant and testing for this pathogen is an important way to verify whether prerequisite whey handling and worker hygiene programs are successful, (c) whey, fines, whey cream, chill water, and brine are potentially important sources of bacterial contamination, (d) enterococci are more likely to be present in one-month-old Cheddar-type and Mozzarella cheeses than coliforms and may be a more useful indicator organism for use in finished product testing, and (e) coliforms are more likely than enterococci to be present in one-month-old fresh-type cheeses and may be an appropriate indicator organism for use with these cheeses. The results emphasize the role that microbiological testing can play in verifying the effectiveness of HACCP and prerequisite programs.

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Food Safety in Food Service: Exploring Public Policy Options

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SUMMARY

How to protect the health of consumers when eating prepared food away from home was the problem that formed the basis of 16 public policy education forums. We used the Alternatives/Consequences Model of Public Policy Education to explore the issue of food safety in food service. The purpose of this program was to provide to a diverse audience the latest factual information on protecting the consumer's health when eating out and an opportunity to assess related alternative policy choices and their consequences. The options and their consequences were developed and presented by a team of university faculty and state department of health staff. Policy options considered at the forums were: maintenance of the status quo (keep things the way they are), regulatory options, food service industry initiatives, and consumer options.

The regulatory options were discussed extensively. Of the 73 small groups reporting at the forums, 68 (93%) recommended at least some regulatory action. Industry options also received support; nearly 60 of the groups recommended some sort of industry initiative. The most frequently mentioned industry option was more training for management and employees. Nearly 40 of the groups recommended one or more consumer options, including education targeted at consumers. Forum participants reported they had gained knowledge during the forums, and 75% believed they could make better decisions about food safety in food service at the close of the forums.

INTRODUCTION

The safety of prepared food sold in retail outlets, such as supermarket delis and convenience stores, and of food served in commercial and noncommercial foodservice operations, is a critical component of the production-to-consumption food system. Food served by these outlets can be hazardous if pathogenic microorganisms are not controlled. Public policy determines the nature of the regulatory systems established at the federal, state, and local levels to protect the public from foodborne disease originating in foodservice establishments and in turn influences food handling practices in these establishments.

Public policy education forums are a useful way to provide factual information to various stakeholders affected by policies. They are designed to enable citizens to make informed policy choices. The mission of the Cooperative Extension Service (CES), to disseminate research-based information that people can use to improve their daily lives, includes a public policy education component. Traditionally, public policy education programs have addressed only agricultural issues. In this study, the principles of public policy education were applied to the public health issue of food safety in foodservice.

This program represented a continuation and expansion of other Kansas State University (KSU) CES food safety programs, but it targeted broader audiences in a new way. The purpose was to provide to a diverse audience the latest factual information on protecting the consumer's health when eating out and to assess related alternative policy choices and their consequences.

PUBLIC POLICY ISSUES

The public health aspects of foodservice sanitation, food handling practices, and regulation meet the criteria of being a public policy issue *(2)*. Such issues:

- Require a group decision. In public policy issues, there are no individual problems, but group problems, which require group decisions.
- Have solutions based on value judgments. If the problem can be settled through scientific analysis, or if someone can come up with the answer in the laboratory, it is not a public problem. Public problems involve value judgments to arrive at solutions. There are no "right" or "wrong" answers to public policy problems. The answer to a public problem will be a compromise based on value judgments as well as on facts and myths.
- Are of broad interest and concern. Frequently, when people in a group discuss public issues, someone will say, "Something ought to be done." Public issues evoke broad interest and concern.
- Are recognized as a problem by key decision makers. A public problem is really not an issue until key decision makers recognize the problem. Educational efforts may begin early in the issue evolution stages.

ALTERNATIVES/ CONSEQUENCES MODEL

We used the Alternatives/Consequences Model of Public Policy Education *(3)*. This model provides a means for participants to separate the facts from the myths surrounding a given policy issue. Participants then have the opportunity to apply their own values in making decisions about the policy alternatives they favor. Program leaders define the problem for participants in a forum setting. The problem definition distinguishes the problem from its symptom, putting the problem into a decision-making framework. The leaders present the policy alternatives, avoiding advocacy for any alternative presented. They elaborate their perceptions of the consequences of each possible action. In small discussion groups, participants confer and assess which actions should be undertaken, combining their values with the information presented. The discussion group leaders report their proposed solutions to the entire forum.

PUBLIC POLICY EDUCATION FORUMS

This interdisciplinary project was a collaborative effort of the KSU-CES, including faculty from the Departments of Foods and Nutrition; Agricultural Economics; Family Studies and Human Services; and Hotel, Restaurant, Institution Management and Dietetics and staff of the Kansas Department of Health and Environment (KDHE). Public policy forums were held throughout the state in 16 of the larger communities.

For each forum, we invited from a given community people who perform roles throughout the food preparation and marketing system. Our interdisciplinary project team worked with the county extension agents hosting each of the 16 forums to identify and recruit participants. Extension agents sent personal letters of invitation and a registration brochure to targeted individuals. We also contacted potential forum participants through the leadership and newsletters of selected organizations. Examples of the associations contacted included the Kansas Restaurant and Hospitality Association, the Kansas School Food Service Association, and the League of Women Voters. Occupations represented included management and first line employees in commercial foodservice occupations, college and university foodservices, school foodservices both public and private, and health care; public health workers; farmers and agribusiness employees; city/county officials; Extension staff; and the general public.

Each educational forum was a one-day session based on the Alternatives/Consequences Model of Public Policy Education. At the outset, we explained the public policy education model and presented the problem question, "How should the safety of consumers eating purchased food prepared away from home be protected?" Project team members presented the policy options and consequences and distributed a policy manual describing the various alternatives and consequences *(4)*. The options were based on expert knowledge of the project team in addition to a review of the relevant literature and data from state agencies. These sources are documented in the policy manual *(4)*.

The four options considered in the forums were: (1) maintenance of the status quo, (2) regulatory options, (3) initiatives of the foodservice industry, and (4) consumer options. Following the presentation of alternatives and consequences, participants were assigned to small discussion groups and deliberately separated from any colleagues with whom they had come to the forum. The groups discussed their varied perspectives on the options and their consequences and attempted to negotiate possible solutions. Group facilitators and recorders kept the discussion moving, allowed everyone the opportunity to express his or her opinions, and facilitated negotiations in selecting a potential solution. Each discussion group reported briefly to the entire group.

Participants completed an evaluation questionnaire and then participated in a question-and-answer session. They directed questions to the moderator, who referred them to the appropriate presenter. The educators on the project team avoided expressing their opinions on policy options.

TABLE 1. Occupations of participants

Occupation	Frequency	Percent
Foodservice Manager/Supervisor	194	36.1
Dietitian	97	18.1
Cook	79	14.7
Extension Agent	47	8.8
Sanitarian/Inspector	35	6.5
Consumer	33	6.1
Educator/Teacher	11	2.0
Farmer	7	1.3
Registered Nurse	7	1.3
No responses	27	5.0
Total	537	100.0

TABLE 2. Training in food sanitation

Training	Frequency	Percent of responses	Percent of respondents
On-the-job training /in service education	330	33.6	61.5
Food sanitation included in course(s)	228	29.4	53.6
Course in food sanitation	194	19.8	36.1
Food handler's certification program	111	11.3	20.7
None	46	4.7	8.6
Other	5	0.5	0.9
No responses	7	0.7	1.3
Total	981	100.0	

EVALUATION

The evaluation procedure used a post-then-pre method of self report, which provides an efficient and effective method for documenting participant perception of changes in knowledge and understanding *(7)*. The questionnaire combined a post-test with a pre-test. This method is efficient because the participant completes the questionnaire once rather than twice. By taking the pre-test at the end of the program, participants can make more valid judgments of their preliminary knowledge, especially if concepts are new to them. The retrospective pre-test at the end of the program is considered more accurate than a pre-test taken before the program, because it is answered in the same frame of reference as the post-test, thus minimizing response shift bias *(7)*. The post-then-pre method has been used successfully for documenting the results of public policy education and leadership development programs and for measuring behavior change in other subject areas *(6)*. The questions assessed changes in awareness, knowledge, understanding, and ability to make informed decisions. We avoided questions that implied advocacy of a particular point of view or policy. The data were prepared and analyzed using dBase and SAS.

A second component of the evaluation involved summarizing the reports of the discussion groups. At each forum, we took notes on the reports given by the group leaders. Each comment was coded and grouped with other comments of similar content. This allowed the full range of comments to be reported *(5)*.

PARTICIPANT CHARACTERISTICS

Attendance averaged 40 participants per forum and ranged from 18 to 54 participants per site for a total of 627 participants. Most participants (86%) completed questionnaires that measured their post-then-pre knowledge of public policy options and understanding of others' viewpoints with regard to these options.

More than 33% of those responding to the questionnaires were managers or supervisors of various types of foodservice operations; approximately 20% were dietitians, and about 15% were cooks. Respondents worked for school foodservices, restaurants, and long-term care facilities (Table 1).

Most of the respondents reported some training in food sanitation (Table 2). Many reported more than one type of training. Over half had food sanitation as a component of one or more courses they had taken, while over 20% reported completing a specific course in food sanitation. Most (62%) reported having on-the-job training or in-service education (Table 2).

TABLE 3. Mean scores, t values, and p values for knowledge and understanding before and at conclusion of forum

Item	Pre-score (meon)[a]	Post-score (meon)[a]	Change-score (meon)[a]	T volues	P volues
Knowledge about:					
The incidence of foodborne illness in Kansos	2.6	3.6	1.1	24.7	.0000
Reasons for low reported numbers of foodborne illnesses	2.7	3.6	0.9	19.9	.0000
Current foodservice sonitation levels	3.1	3.8	0.7	17.1	.0000
Current foodservice inspection program	3.0	3.8	0.8	19.4	.0000
Areos to be included in a self-inspection progrom	2.8	3.6	0.8	19.4	.0000
Meons of enhancing the existing foodservice inspection progrom	2.6	3.7	1.1	23.9	.0000
The Hazard Analysis Critical Control Point progrom	1.9	3.4	1.5	28.8	.0000
Content of a monager certificotion program	2.3	3.3	1.0	20.5	.0000
Existence of state and local requirements regarding training of foodservice managers and employees	2.5	3.5	0.9	20.5	.0000
The importance of supervision of employees	3.7	4.1	0.5	12.4	.0000
Consumer ottitudes obout food sofety	3.2	3.9	0.7	18.0	.0000
Reosons for the chonges in consumer preferences over time for meols purchosed owoy from home	3.1	3.8	0.7	17.3	.0000
Understanding the viewpoints of others about:					
The role of informotion/educotion in consumer decisions about food safety	2.9	3.7	0.8	23.6	.0000
The role of foodservice operotions in protecting the public health	3.3	4.0	0.7	18.0	.0000
The importance of training programs for foodservice employees	3.5	4.2	0.7	16.5	.0000
The role of stote ond local health agencies in protecting the public from foodborne illnesses	3.2	4.0	0.8	20.4	.0000
Consumer responsibilities ond priorities reloted to food sofety	3.0	3.8	0.8	20.5	.0000
Consequences of each option for addressing food safety in foodservice	2.7	3.8	1.1	23.8	.0000

[a]Means calculated on following scale: 1–none, 2–little, 3–moderate, 4–much, 5–complete
N=537

KNOWLEDGE AND UNDERSTANDING GAINED

Participants rated their post-then-pre knowledge and understanding of information presented on Likert scales. For each item, the group as a whole rated their knowledge and understanding significantly higher following the forum than before (Table 3).

The items about which the respondents knew least prior to the meeting were: "the Hazard Analysis and Critical Control Point (HACCP) program," "the content of a manager certification program," "the status of state and local requirements regarding the training of foodservice managers and employees," "the possible means of enhancing the existing foodservice inspection program," and "the incidence of foodborne illness." These items tended to be the same items of which the respondents

Figure 1. Knowledge and understanding before and at conclusion of forum.

showed the greatest increase in knowledge and understanding during the course of the meeting. These differences are graphically represented in Fig. 1. The item about which the respondents knew the most prior to the forums and learned the least was "the importance of the supervision of employees." Other items about which the respondents reported knowing the most prior to the meeting were "the viewpoints of others about the role of foodservice operations in protecting the public health" and "the importance of training programs for foodservice employees."

In general, the participants seemed most knowledgeable and had the greatest understanding of items related to the importance of the issue of food safety, the need for ongoing training, and appropriate standards of operation. They were least familiar with items related to the specifics of the current situation in the state (status quo) and the regulatory alternatives. Most participants (75%) believed they were more capable of making informed decisions about food safety related to foodservice at the close of the forums.

SUMMATION OF DISCUSSION GROUP REPORTS

At each forum site, participants formed discussion groups of 7 to 12 persons to share their reactions to the policy alternatives and consequences presented. Seventy-three groups reported at the sixteen sites. In considering the opinions expressed, it is important to bear in mind that the participants did not represent the population of the state. Rather they were individuals who had been invited because of their significant personal stakes in the policy issues being discussed. In some cases, the discussion groups recommended their own original policy alternatives; these are reported here even though they were not evaluated with regard to their consequences. Another consideration is that the policy options presented by the project team were evaluated without regard to their cost by both the team and the discussion groups. One exception was the recognition by several groups that many of the regulatory options would require more funding for the regulatory agencies.

The status quo

Two groups commented that the status quo represented the best that could be expected to be achieved, but most groups expressed dissatisfaction with the status quo. One group commented that "Safe food should be a given for everyone" and went on to make recommendations involving changes in the status quo. One group commented, "Foodservice employees feel closely watched and regulated." Many groups acknowledged the importance of the existing regulatory system in maintaining the current level of food safety.

Regulatory alternatives

The regulatory options proposed drew considerable support. Many groups commented on the need for clear, enforceable food safety standards. School and health care facilities were perceived as being more thoroughly regulated than other foodservice establishments. The group reporters cited the need for more funding for regulatory agencies, some stating that more or increased foodservice licensing fees could be a source of additional funds. Also cited were needs for more inspectors, better trained inspectors, more frequent inspections, longer

inspections, more follow-up inspections, and more thorough inspections of such areas as salad bars, hot food lines and the exterior site. Another need cited was the need for greater consistency in the inspections among different inspectors. One group suggested that inspections be done "on all work shifts of the restaurant, not just the day shift." Several groups suggested that the inspection visit be structured so that the inspector would have time to consult with management on how to correct identified deficiencies and/or to do other needed teaching.

Many groups felt the HACCP approach should be implemented for inspections. They commented that the present inspection approach did not put sufficient emphasis on safe foodhandling procedures. One group suggested the HACCP approach be used to reinspect facilities scoring poorly on the traditional inspection.

Many groups advocated certification or even licensing of managers. Some felt that the requirements for opening a new restaurant should include some amount of training of staff or management. In turn, some groups proposed that managers be certified to train their own staff. Two groups recommended a requirement that any foodservice establishment always have a certified manager on duty. One group recommended that managers be trained in the principles of HACCP. Another group stated that manager certification should involve a requirement for ongoing in-service training and recertification.

Some groups recommended that more enforcement actions, such as fines and revocation or suspension of licenses, should be implemented. One group recommended an increased fee for follow-up inspections.

Some groups advocated a return to health testing of foodservice employees. This was not a policy option presented by the project team. More groups advocated training requirements for employees in food safety leading to certification. A few groups stated that this certification should include a requirement for ongoing training and recertification. Some groups recommended certification training programs by the KDHE and/or some effort to standardize the training available. One such recommendation was to mandate that each licensed foodservice operation have a teaching plan on file. A need was also cited for greater awareness of the existing regulations by foodservice management and staff and by the public.

Another recommended enhancement of the existing regulatory system involved restructuring the current agency roles. One group advocated coordination of the inspections conducted by the KDHE and those conducted by the Kansas Department of Agriculture (KDA). Several groups recommended that the KDHE contract more foodservice inspections with local/county agencies. Overall, the regulatory options received a great deal of discussion. Of the seventy-three groups reporting, 93% recommended at least one of the regulatory options.

Industry alternatives

Similarly, the industry consequences received considerable discussion. A few groups believed industry did not have sufficient incentive to take the possible initiatives. However, nearly 60 groups recommended some sort of industry initiative. Many commented specifically that industry was responsive to the consumer's desire for cleanliness.

The most commonly recommended industry initiative was the need for more training of management and employees. Many groups cited the importance of adequate training when foodservice employees are first hired and indicated that this was management's responsibility. Managers were perceived as needing more training in food safety/sanitation in order to provide adequate staff training and supervision. Several groups cited the need for ongoing training of management and staff. Others recommended that training was most effective when it was offered at the employment site. Disparities were noted among different types of foodservice establishments regarding the resources available to support training. Restaurant chains, school foodservice and hospitals were all noted as having more resources than independent restaurants. The rapid turnover of foodservice employees, time limitations and other costs were identified as barriers to providing adequate training.

Over half of the groups identified other needed industry initiatives, including ongoing self inspection or quality control and effective supervision of employees. Several groups recommended that foodservice employers take steps to increase the pride and self esteem of foodservice employees and/or offer support or incentives to staff to achieve improved sanitation. Again, chain restaurants were noted as having more resources to support these efforts than independent restaurants. HACCP was recognized as a useful tool to accomplish many of these objectives.

Many groups discussed sources or mechanisms of leadership or support within the foodservice industry for these recommended initiatives. These include the national and state restaurant associations, the state and national dietary managers associations, and development of advisory committees. Many groups advocated for the creation of opportunities for restaurants and institutions to share and compare ideas that work.

Consumer alternatives

Although a few groups expressed doubt that consumers could have a significant impact on food safety practices of foodservice establishments, nearly 40 groups did recommend one or more of the consumer-based options. Many groups commented that consumers were concerned about cleanliness of foodservice establishments and that, in turn, consumer satisfaction drove the industry. Some groups expressed concerns regarding the hygiene practices of consumers when eating out. One such concern was the behavior of children at salad bars. A few groups recommended education efforts targeted at improving these behaviors. Many groups recommended education targeted to consumers to make them more aware of the existing regulations and the state of sanitation in

foodservice establishments. Some groups felt that posting inspection scores in restaurants or awarding seals of approval to restaurants scoring above some specified score would be useful. Several groups mentioned that consumers need more information about how and to whom to report concerns, such as the importance of and procedure for reporting possible foodborne illness. Greater media attention to this issue, such as the publication of facility inspection scores in local newspapers, also was recommended. The posting and/or publication of facility inspection scores are other examples of suggested policy options arising from the discussion groups.

SUMMARY OF ALL OF THE ALTERNATIVES

A few groups expressed concern that none of the major proposed options were adequate. Others felt that a combination of all the options offered the best solution. The most common solution offered was a combination of the regulatory and industry initiatives. Several groups recommended that industry and the health department collaborate to develop new regulations. Another idea arising from the group discussions, representing a combination of the regulatory option and the consumer option, was an 800 toll-free telephone number to be operated by the state health department to facilitate consumer complaints and target inspections.

Overall, there was considerable discussion given to steps that could be taken to provide more and improved training resources. The KDHE and the county health department, the Cooperative Extension Service, community colleges, and the foodservice industry were all identified as significant players in this process. One group recommended that these organizations collaborate to come up with a statewide plan for foodservice food-safety training. Videos, the university telenet system, and sanitation check lists were all recommended as low cost, effective training tools. Efforts to publicize existing training resources also were recommended. Several groups recommended that training expertise and/or resources be available locally throughout the state and that the availability of these resources be well publicized.

DISCUSSION

The collaborations formed will build stronger programs and maximize use of agency resources. The KDHE can collaborate with the Extension network to identify and carry out training. The Department of Hotel, Restaurant, Institution Management and Dietetics at KSU has developed a strong link to Extension. This link can now be used to clarify training needs in the area of foodservice management and to create plans to meet these needs.

As a result of the project, numerous follow-up collaborative projects evolved *(1)*. Each of these projects represents a step toward long term collaboration among the Cooperative Extension Service, the regulatory agency, and the foodservice industry around the issue of food safety in foodservice. Through the program, the CES has been positioned for an educational role in foodservice. Networks were established with broader audiences, such as restaurant managers; public health sanitarians; hospital, nursing home, university, and school foodservice personnel; and local government officials. This project has established an important new educational role for the Cooperative Extension Service, which capitalizes on its interdisciplinary expertise and its established local networks, including linkages with professional societies and community organizations. Opportunities for expansion of the traditional role of Extension as a leader in public policy education on non-agricultural issues were established. Complete project information is available in the project report *(5)*.

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EMERGING FOODBORNE DISEASES: AN EVOLVING PUBLIC HEALTH CHALLENGE

Robert V. Tauxe

The epidemiology of foodborne disease is changing. New pathogens have emerged, and some have spread worldwide. Many, including *Salmonella*, *Escherichia coli* O157:H7, *Campylobacter*, and *Yersinia enterocolitica*, have reservoirs in healthy food animals, from which they spread to an increasing variety of foods. These pathogens cause millions of cases of sporadic illness and chronic complications, as well as large and challenging outbreaks over many states and nations. Improved surveillance that combines rapid subtyping methods, cluster identification, and collaborative epidemiologic investigation can identify and halt large, dispersed outbreaks. Outbreak investigations and case-control studies of sporadic cases can identify sources of infection and guide the development of specific prevention strategies. Better understanding of how pathogens persist in animal reservoirs is also critical to successful long-term prevention. In the past, the central challenge of foodborne disease lay in preventing the contamination of human food with sewage or animal manure. In the future, prevention of foodborne disease will increasingly depend on controlling contamination of feed and water consumed by the animals themselves.

Every year, in the United States foodborne infections cause millions of illnesses and thousands of deaths; most infections go undiagnosed and unreported. As the epidemiology of foodborne infections evolves, old scenarios and solutions need to be updated. This article reviews main trends in the evolution of foodborne disease epidemiology and their effect on surveillance and prevention activities.

Preventing foodborne disease is a multifaceted process, without simple and universal solutions. For most foodborne pathogens, no vaccines are available. Consumer education about basic principles of food safety, an important component of prevention, by itself is insufficient. Food reaches the consumer through long chains of industrial production, in which many opportunities for contamination exist. The general strategy of prevention is to understand the mechanisms by which contamination and disease transmission can occur well enough to interrupt them. An outbreak investigation or epidemiologic study should go beyond identifying a suspected food and pulling it from the shelf to defining the chain of events that allowed contamination with an organism in large enough numbers to cause illness. We learn from the investigation what went wrong, in order to devise strategies to prevent similar events in the future. Although outbreaks make the news, most foodborne infections occur as individual or sporadic cases. Therefore, the sources of sporadic cases must also be investigated and understood.

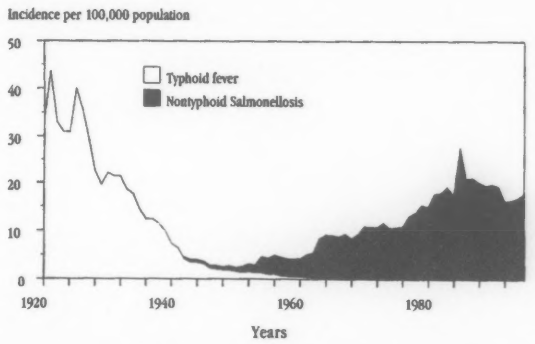
EMERGING FOODBORNE PATHOGENS

Substantial progress has been made in preventing foodborne diseases. For example, typhoid fever, extremely common at the beginning of the 20th century, is now almost forgotten in the United States. It was conquered in the preantibiotic era by disinfection of drinking water, sewage treatment, milk sanitation and pasteurization, and shellfish bed sanitation (Fig. 1). Similarly, cholera, bovine tuberculosis, and trichinosis have also been controlled in the United States. However, new foodborne pathogens have emerged. Among the first of these were infections caused by nontyphoid strains of *Salmonella*, which have increased decade by decade since World War II (Fig. 1). In the last 20 years, other infectious agents have been either newly described or newly associated with foodborne transmission (Table 1). *Vibrio vulnificus*, *Escherichia coli* O157:H7, and *Cyclospora cayetanensis* are examples of newly described pathogens that often are foodborne. *V. vulnificus* was identified in the bloodstream of persons with underlying liver disease who had fulminant infections after eating raw oysters or being exposed to seawater; this organism lives in the sea and can be a natural summertime commensal

TABLE 1. New pathogens that are foodborne and pathogens newly recognized as predominantly foodborne in the United States in the last 20 years

Campylobacter jejuni
Campylobacter fetus spp. *fetus*
Cryptosporidium cayetanensis
Escherichia coli O157:H7 and related *E. coli* (e.g., O111:NM, O104:H21)
Listeria monocytogenes
Norwalk-like viruses
Nitzschia pungens (cause of amnesic shellfish poisoning)
Salmonella enteritidis
Salmonella typhimurium DT 104
Vibrio cholerae O1
Vibrio vulnificus
Vibrio parahaemolyticus
Yersinia enterocolitica

Figure 1. Reported incidence of typhoid fever and nontyphoidal salmonellosis in the United States, 1920 to1995.



organism in shellfish *(1)*. *E. coli* O157:H7 was first identified as a pathogen in 1982 in an outbreak of bloody diarrhea traced to hamburgers from a fast-food chain *(2)*; it was subsequently shown to have a reservoir in healthy cattle *(3)*. *Cyclospora*, known previously as a cyanobacterialike organism, received its current taxonomic designation in 1992 and emerged as a foodborne pathogen in outbreaks traced to imported Guatemalan raspberries in 1996 *(4, 5)*. The similarity of *Cyclospora* to Eimeria coccidian pathogens of birds suggests an avian reservoir *(4, 5)*.

Some known pathogens have only recently been shown to be predominantly foodborne. For example, *Listeria monocytogenes* was long known as a cause of meningitis and other invasive infections in immunocompromised hosts. How these hosts became infected remained unknown until a series of investigations identified food as the most common source *(6)*. Similarly, *Campylobacter jejuni* was known as a rare opportunistic bloodstream infection until veterinary diagnostic methods used on specimens from humans showed it was a common cause of diarrheal illness *(7)*. Subsequent epidemiologic investigations implicated poultry and raw milk as the most common sources of sporadic cases and outbreaks, respectively *(8)*. *Yersinia enterocolitica*, rare in the United States but a common cause of diarrheal illness and pseudoappendicitis in northern Europe and elsewhere, is now known to be most frequently associated with undercooked pork *(9)*.

These foodborne pathogens share a number of characteristics. Virtually all have an animal reservoir from which they spread to humans; that is, they are foodborne zoonoses. In marked contrast to many established zoonoses, these new zoonoses do not often cause illness in the infected host animal. The chicken with lifelong ovarian infection with *Salmonella* serotype Enteritidis, the calf carrying *E. coli* O157:H7, and the oyster carrying Norwalk virus or *V. vulnificus* appear healthy; therefore, public health concerns must now include apparently healthy animals. Limited existing research on how animals acquire and transmit emerging pathogens among themselves often implicates contaminated fodder and water; therefore, public health concerns must now include the safety of what food animals themselves eat and drink.

For reasons that remain unclear, these pathogens can rapidly spread globally. For example, *Y. enterocolitica* spread globally among pigs in the 1970s *(10)*; *Salmonella* serotype Enteritidis appeared simultaneously around the world in the 1980s *(11)*; and *Salmonella typhimurium* Definitive Type (DT) 104 is now appearing in North America, Europe, and perhaps elsewhere *(12)*; therefore, public health concerns must now include events happening around the world, as harbingers of what may appear here.

Many emerging zoonotic pathogens are becoming increasingly resistant to antimicrobial agents, largely because of the widespread use of antibiotics in the animal reservoir. For example, *Campylobacter* isolated from human patients in Europe is now increasingly resistant to fluoroquinolones, after these agents were introduced for use in animals *(13)*. Salmonellae have become increasingly resistant to a variety of antimicrobial agents in the United States *(14)*; therefore, public health concerns must include the patterns of antimicrobial use in agriculture as well as in human medicine.

The foods contaminated with emerging pathogens usually look, smell, and taste normal, and the pathogen often survives traditional preparation techniques: *E. coli* O157:H7 in meat can survive the gentle heating that a rare hamburger gets *(15)*; *Salmonella enteritidis* in eggs survives in an omelette *(16)*; and Norwalk virus in oysters survives gentle steaming *(17)*. Following standard and traditional recipes can cause illness and outbreaks. Contamination with the new foodborne zoonoses eludes traditional food inspection, which relies on visual identi-

fication of foodborne hazards. These pathogens demand new control strategies, which would minimize the likelihood of contamination in the first place. The rate at which new pathogens have been identified suggests that many more remain to be discovered. Many of the foodborne infections of the future are likely to arise from the animal reservoirs from which we draw our food supply.

Once a new foodborne disease is identified, a number of critical questions need to be answered to develop a rational approach to prevention: What is the nature of the disease? What is the nature of the pathogen? What are simple ways to easily identify the pathogen and diagnose the disease? What is the incidence of the infection? How can the disease be treated? Which foods transmit the infection? How does the pathogen get into the food, and how well does it persist there? Is there is an animal reservoir? How do the animals themselves become infected? How can the disease be prevented? Does the prevention strategy work?

The answers to these questions do not come rapidly. Knowledge accumulates gradually, as a result of detailed scientific investigations,often conducted during outbreaks *(18)*. After 15 years of research, we know a great deal about infections with *E. coli* O157:H7, but we still do not know how best to treat the infection, nor how the cattle (the principal source of infection for humans) themselves become infected. Better slaughter procedures and pasteurization of milk are useful control strategies for this pathogen in meat and milk, as irradiation of meat may be in the future. More needs to be learned: for example, it remains unclear how best to prevent this organism from contaminating lettuce or apple juice. For more recently identified agents, even less is known.

New Food Vehicles of Transmission

Along with new pathogens, an array of new food vehicles of transmission have been implicated in recent years. Traditionally, the food implicated in a foodborne outbreak was undercooked meat, poultry or seafood, or unpasteurized milk. Now, additional foods previously thought safe are considered hazardous. For example, for centuries, the internal contents of an egg were presumed safe to eat raw. However, epidemic *Salmonella enteritidis* infection among egg-laying flocks indicates that intact eggs may have internal contamination with this *Salmonella* serotype. Many outbreaks are caused by contaminated shell eggs, including eggs used in such traditional recipes as eggnog and Caesar salad, lightly cooked eggs in omelettes and French toast, and even foods one would presume thoroughly cooked, such as lasagna and meringue pie *(19, 20)*. *E. coli* O157:H7 has caused illness through an ever-broadening spectrum of foods, beyond the beef and raw milk that are directly related to the bovine reservoir. In 1992, an outbreak caused by apple cider showed that this organism could be transmitted through a food with a pH level of less than 4.0, possibly after contact of fresh produce with manure *(21)*. A recent outbreak traced to venison jerky suggests a wild deer reservoir, so both cattle and feral deer manure are of concern *(22)*. Imported raspberries contaminated with *Cyclospora* caused an epidemic in the United States in 1996, possibly because contaminated surface water was used to spray the berries with fungicide before harvest *(5)*. Norwalk-like viruses, which appear to have a human reservoir, have contaminated oysters harvested from pristine waters by oyster catchers who did not use toilets with holding tanks on their boats and were themselves the likely source of the virus *(23)*.

The new food vehicles of disease share several features. Contamination typically occurs early in the production process, rather than just before consumption. Because of consumer demand and the global food market, ingredients from many countries may be combined in a single dish, which makes the specific source of contamination difficult to trace. These foods have fewer barriers to microbial growth, such as salt, sugar, or preservatives; therefore, simple transgressions can make the food unsafe. Because the food has a short shelf life, it may often be gone by the time the outbreak is recognized; therefore, efforts to prevent contamination at the source are very important.

An increasing, though still limited, proportion of reported foodborne outbreaks are being traced to fresh produce *(24)*. A series of outbreaks recently investigated by the Centers for Disease Control and Prevention (CDC) has linked a variety of pathogens to fresh fruits and vegetables harvested in the United States and elsewhere (Table 2). The investigations have often been triggered by detection of more cases than expected of a rare serotype of *Salmonella* or *Shigella* or by diagnosis of a rare infection like cyclosporiasis. Outbreaks caused by common serotypes are more likely to be missed. Various possible points of contamination have been identified during these investigations, including contamination during production and harvest, initial processing and packing, distribution, and final processing (Table 3). For example, fresh or inadequately composted manure is used sometimes, although *E. coli* O157:H7 has been shown to survive for up to 70 days in bovine feces *(25)*. Untreated or contaminated water seems to be a particularly likely source of contamination. Water used for spraying, washing, and maintaining the appearance of produce must be microbiologically safe. After two large outbreaks of salmonellosis were traced to imported cantaloupe, the melon industry considered a "Melon Safety Plan," focusing particularly on the chlorination of water used to wash melons and to make ice for shipping them. Although the extent to which the plan was implemented is unknown, no further large outbreaks have occurred. After two large outbreaks of salmonellosis were traced to a single tomato packer in the Southeast, an automated chlorination system was developed for the packing plant wash tank. Because tomatoes absorb water (and associated bacteria) if washed in water colder than they are, particular attention was also focused on the temperature of the water bath *(26, 27)*. No further outbreaks have been linked to southeastern tomatoes. Similar attention is warranted for water used to rinse lettuce heads in packing sheds and to crisp them in grocery stores as well as for water used in processing other fresh produce.

Figure 2. *Salmonella enteritidis* isolation rates from humans by region, United States, 1970 to 1996.

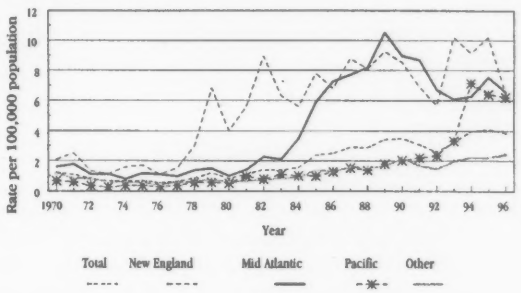


TABLE 2. Foodborne outbreaks traced to fresh produce 1990 to 1996

Yr.	Pathogen	Vehicle	Cases (no.)	States (no.)	Sources
'90	*S. chester*	Cantaloupe	245	30	C.A.[a]
'90	*S. javiana*	Tomatoes	174	4	U.S.[b]
'90	Hepatitis A	Strawberries	18	2	U.S.
'91	*S. poona*	Cantaloupe	>400	23	U.S./ C.A
'93	*E. coli* O157:H7	Apple cider	23	1	U.S.
'93	*S. montevideo*	Tomatoes	84	3	U.S.
'94	*Shigella flexneri*	Scallions	72	2	C.A.
'95	*S. stanley*	Alfalfa sprouts	24	27	N.K.[c]
'95	*S. hartford*	Orange juice	63	21	U.S.
'95	*E. coli* O157:H7	Leaf lettuce	70	1	U.S.
'96	*E. coli* O157:H7	Leaf lettuce	49	2	U.S.
'96	*Cyclospora*	Raspberries	978	20	C.A.
'96	*E. coli* O157:H7	Apple juice	71	3	U.S.

[a]Central America
[b]United States
[c]Source unknown

A New Outbreak Scenario

Because of changes in the way food is produced and distributed, a new kind of outbreak has appeared. The traditional foodborne outbreak scenario often follows a church supper, family picnic, wedding reception, or other social event. This scenario involves an acute and highly local outbreak, with a high inoculum dose and a high attack rate. The outbreak is typically immediately apparent to those in the local group, who promptly involve medical and public health authorities. The investigation identifies a food-handling error in a small kitchen that occurs shortly before consumption. The solution is also local. Such outbreaks still occur, and handling them remains an important function of a local health department.

However, diffuse and widespread outbreaks, involving many counties, states, and even nations *(28)*, are identified more frequently and follow an entirely different scenario. The new scenario is the result of low-level contamination of a widely distributed commercial food product. In most jurisdictions, the increase in cases may be inapparent against the background illness. The outbreak is detected only because of a fortuitous concentration of cases in one location, because the pathogen causing the outbreak is unusual, or because laboratory-based subtyping of strains collected over a wide area identifies a diffuse surge in one subtype. In such outbreaks, investigation can require coordinated efforts of a large team to clarify the extent of the outbreak, implicate a specific food, and determine the source of contamination. Often, no obvious terminal food-handling error is found. Instead, contamination is the result of an event in the industrial chain of food production. Investigating, controlling, and preventing such outbreaks can have industrywide implications.

These diffuse outbreaks can be caused by a variety of foods. Because fresh produce is usually widely distributed, most of the produce-related outbreaks listed in Table 2 were multistate events. Some of the largest outbreaks affected most states at once. For example, a recent outbreak of *Salmonella enteritidis* infections caused by a nationally distributed brand of ice cream affected the entire nation *(29)*. Although it caused an estimated 250,000 illnesses, it was detected only when vigorous routine surveillance identified a surge in reported infections with *S. enteritidis* in one area of southern Minnesota. The consumers affected did not make food-handling errors with their ice cream, so food safety instruction could not have prevented this outbreak. The ice cream premix was transported after pasteurization to the ice cream factory in tanker trucks that had been used to haul raw eggs. The huge epidemic was the result of a basic failure on an industrial scale to separate the raw from the cooked.

S. enteritidis infections also illustrate why surveillance and investigation of sporadic cases are needed. A diffuse increase in sporadic cases can occur well before a local or large outbreak focuses attention on the emergence of a pathogen. The isolation rate for *S. enteritidis* began to increase sharply in the New England region in 1978 (Fig. 2); all cases were sporadic. In 1982, an outbreak in a New England nursing home was traced to eggs from a local supplier. However, the egg connection was not really appreciated until 1986, when a large multistate outbreak of *S. enteritidis* infections was traced to stuffed pasta made with raw eggs and labeled "fully cooked." This outbreak, affecting an estimated 3,000 persons in seven states, led to the documentation that *S. enteritidis* was present on egg-laying farms and to the subsequent demonstration that both outbreaks and sporadic cases of infections were associated with shell eggs *(19, 30)*. Since then, Enteritidis has become the most common serotype of *Salmonella* isolated in the United States, accounting for

Figure 3. Incidence of three infections in FoodNet surveillance areas, 1996.

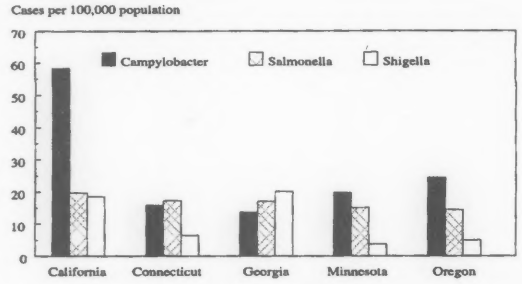


TABLE 3. Events and potential contamination sources during produce processing

Event	Contamination sources
Production and harvest	
Growing, picking, bundling	Irrigation water, manure, lack of field sanitation
Initial processing	
Washing, waxing, sorting, boxing	Wash water, handling
Distribution	
trucking	Ice, dirty trucks
Final processing	
Slicing, squeezing, shredding, peeling	Wash water, handling, cross-contamination

25% of all *Salmonella* reported in the country and causing outbreaks coast to coast. Eggs remain the dominant source of these infections, causing large outbreaks when they are pooled and undercooked and individual sporadic cases among consumers who eat individual eggs *(20, 31)*. Perhaps focused investigation and control measures taken when the localized increase in sporadic *Salmonella* cases was just beginning might have prevented the subsequent spread.

Changing Surveillance Strategies

In the United States, surveillance for diseases of major public health importance has been conducted for many years. The legal framework for surveillance resides in the state public health epidemiology offices, which share data with CDC. The first surveillance systems depended on physician or coroner notification of specific diseases and conditions, with reports going first to the local health department, then to state and federal offices. Now electronic, this form of surveillance is still used for many specific conditions *(32)*. In 1962, a second channel was developed specifically for *Salmonella*, to take advantage of the added public health information provided by subtyping the strains of bacteria *(33)*. Clinical laboratories that isolated *Salmonella* from humans were requested or required to send the strains to the state public health laboratory for serotyping. Although knowing the serotype is usually of little benefit to the individual patient, it has been critical to protecting and improving the health of the public at large. Serotyping allows cases that might otherwise appear unrelated to be included in an investigation because they are of the same serotype. Moreover, infections that are close in time and space to an outbreak but are caused by nonoutbreak serotypes and are probably unrelated can be discounted. Results of serotyping are now sent electronically from public health laboratories and can be rapidly analyzed and summarized. *Salmonella* serotyping was the first subtype-based surveillance system and is a model for similar systems *(34)*. Yet another source of surveillance data involves summary reports of foodborne disease outbreak investigations from local and state health departments *(35)*. About 400 such outbreaks are reported annually, by a system that remains paper-based, labor-intensive, and slow.

Existing surveillance systems provide a limited and relatively inexpensive net for tracing large-scale trends in foodborne diseases under surveillance and for detecting outbreaks of established pathogens in the United States. However, they are less sensitive to diffuse outbreaks of common pathogens, provide little detail on sporadic cases, and are not easy to extend to emerging pathogens. In the future, changes in health delivery may impinge on the way that diagnoses are made and reported, leading to artifactual changes in reported disease incidence.

Therefore, CDC, in collaboration with state health departments and federal food regulatory agencies, is enhancing national surveillance for foodborne diseases in several ways. First, the role of subtyping in public health laboratories is being expanded to encompass new molecular subtyping methods. Beginning in 1997, a national subtyping network for *E. coli* O157:H7 of participating state public health department laboratories and CDC will use a single standardized laboratory protocol to subtype strains of this important pathogen. The standard method, pulsed-field gel electrophoresis, can be easily adapted to other bacterial pathogens. In this network, each participating laboratory will be able to routinely compare the genetic gel patterns of strains of *E. coli* O157:H7 with the patterns in a national pattern bank. This will enable rapid detection of clusters of related cases within the state and will focus investigative resources on the cases most likely to be linked. It will also enable related cases scattered across several states to be linked so that a common source can be sought.

Another surveillance strategy, now implemented, is active surveillance in sentinel populations. Since January 1996, at five U.S. sentinel sites, additional surveillance resources make it possible to contact laboratories directly for regular reporting of bacterial infections likely to be foodborne *(36)*; (Fig. 3). In addition, surveys of the population, physicians, and laboratories measure the proportion of diarrheal diseases that are undiagnosed and unreported so that the true disease incidence can be estimated. This surveillance, known as FoodNet, is the platform on

which more detailed investigations, including case-control studies of sporadic cases of common foodborne infections, are being conducted.

Yet another new surveillance initiative is the routine monitoring of antimicrobial resistance among a sample of *Salmonella* and *E. coli* O157:H7 bacteria isolated from humans *(37)*. A new cluster detection algorithm is being applied routinely to surveillance data for *Salmonella* at the national level, making it possible to detect and flag possible outbreaks as soon as the data are reported *(38)*. Implementation of such algorithms for other infections and at the state level will further increase the usefulness of routine surveillance.

Further enhancements are possible as active surveillance through FoodNet is extended to a wider spectrum of infections, including foodborne parasitic and viral infections. In 1997, active surveillance for *Cyclospora* began in FoodNet, which quickly resulted in the detection of a diffuse outbreak among persons who had been on a Caribbean cruise ship that made stops in Mexico and Central America (CDC, unpublished data). Application of standardized molecular subtyping methods to other foodborne pathogens will provide a more sensitive warning system for diffuse outbreaks of a variety of pathogens. To handle outbreaks in areas not covered by FoodNet, standard surveillance and investigative capacities in state health department epidemiology offices and laboratories should be strengthened. In addition, enhanced international consultation will be critical to better detect and investigate international or global outbreaks *(28)*.

Implications of the New Outbreak Scenario for Public Health Activities

Our public health infrastructure is tiered, both in surveillance responsibilities and in response to emergency situations *(39)*. At the local level, the county or city health department, first developed in response to epidemic cholera and other challenges in the 19th century, is responsible for most basic surveillance, investigation, and prevention activities. At the state level, epidemiologists, public health laboratorians, sanitarians, and educators conduct statewide surveillance and prevention activities and consult with and support local authorities. At the national level, CDC is the primary risk-assessment agency for public health hazards and conducts the primary national surveillance as well as epidemic response in support of state health departments. The Food and Drug Administration, Department of Agriculture, and Environmental Protection Agency are the primary regulatory agencies, charged with specific responsibilities regarding the nation's food and water supplies that interlock and are not always predictable. The Food and Drug Administration regulates low-acid canned foods, imported foods, pasteurized milk, many seafoods, rabbits raised for meat, and food and water provided on aircraft and trains. The Department of Agriculture regulates meat and poultry, including primary slaughter and further processing, and pasteurized eggs; investigates animal and plant diseases; and maintains the county extension outreach program. Shell eggs do not have a clear regulatory home, as the Department of Agriculture regulates the grading of shell eggs for quality, but the Food and Drug Administration, since 1995, has responsibility for the microbiologic safety of shell eggs.

The new outbreak scenario has several implications for the practice of public health, starting at the local level. One is that when diffuse outbreaks are detected, a local health department may need to investigate a few cases that are part of a larger outbreak despite their apparently small local impact. Second, an apparently local outbreak may herald the first recognized manifestation of a national or even international event.

When a diffuse outbreak of a potentially foodborne pathogen is detected, rapid investigation is needed to determine whether the outbreak is foodborne, and if possible, identify a specific food vehicle. These investigations, which typically include case-control studies, may need to be conducted in several locations at once. While all cases or all affected states may not need to be included in such an investigation, combining cases from several locations in one investigation and repeating the investigation in more than one location can be helpful. For example, in a recent international outbreak of *Salmonella stanley* infections traced to alfalfa sprouts, concentrations of cases in Arizona, Michigan, and Finland led to case-control studies in each location, each of which linked illness to eating sprouts grown from the same batch of alfalfa seeds. This proved that the seeds were contaminated at the source *(40)*. Parallel investigations can also lead to new twists. In the large West Coast outbreak of *E. coli* O157:H7 infections in 1993, a parallel investigation conducted in Nevada identified a type of hamburger other than the one implicated in the initial case-control investigation in Washington, leading to a broader recall and a more complete investigation of the circumstances of contamination *(15, 41)*. Because well-conducted investigations may lead to major product recalls, industrial review, and overhaul, and even international embargoes, it is essential that they be of the highest scientific quality.

Foodborne outbreaks are investigated for two main reasons. The first is to identify and control an ongoing source by emergency action: product recall, restaurant closure, or other temporary but definitive solutions. The second reason is to learn how to prevent future similar outbreaks from occurring. In the long run this second purpose will have an even greater impact on public health than simply identifying and halting the outbreaks. Because all the answers are not available and existing regulations may not be sufficient to prevent outbreaks, the scientific investigation often requires a careful evaluation of the chain of production. This traceback is an integral part of the outbreak investigation. It is not a search for regulatory violations, but rather an effort to determine where and how contamination occurred. Often, the contamination scenario reveals that a critical point has been lost. Therefore, epidemiologists must participate in traceback investigations.

Intervention during outbreaks often depends on having enough good epidemiologic data to act with confidence, without waiting for a definitive laboratory test, particularly if potentially lethal illnesses are involved. For

example, if five persons with classic clinical botulism ate at the same restaurant the preceding day (but have nothing else apparent in common), prudence dictates closing the restaurant quickly while the outbreak is sorted out—that is, before a specific food is identified or confirmatory cultures are made, which may take several days or even weeks. Good epidemiologic data, including evidence of a clear statistical association with a specific exposure, biologic plausibility of the illness syndrome, the potential hazard of that food, and the logical consistency of distribution of the suspect food and cases are essential.

The role of the regulatory agency laboratory is also affected by the new scenario. Because of the short shelf life and broad distribution of many of the new foods responsible for infection, by the time the outbreak is recognized and investigated the relevant food may no longer be available for culture. Because contamination may be restricted to a single production lot, blind sampling of similar foods that does not include the implicated lot can give a false sense of security. Good epidemiologic information pointing to contamination of a specific food or production lot should guide the microbiologic sampling and the interpretation of the results. Available methods may be insufficient to detect low-level contamination, even of well-established pathogens.

New Approaches to the Prevention of Foodborne Disease

Meeting the complex challenge of foodborne disease prevention will require the collaboration of regulatory agencies and industry to make food safely and keep it safe throughout the industrial chain of production. Prevention can be "built in" to the industry by identifying and controlling the key points—from field, farm, or fishing ground to the dinner table—at which contamination can either occur or be eliminated. The general strategy known as Hazard Analysis and Critical Control Points (HACCP) replaces the strategy of final product inspection. Some simple control strategies are self-evident, once the reality of microbial contamination is recognized. For example, shipping fruit from Central America with clean ice or in closed refrigerator trucks, rather than with ice made from untreated river water, is common sense. Similarly, requiring oyster harvesters to use toilets with holding tanks on their oyster boats is an obvious way to reduce fecal contamination of shallow oyster beds. Pasteurization provides the extra barrier that will prevent *E. coli* O157:H7 and other pathogens from contaminating a large batch of freshly squeezed juice.

For many foodborne diseases, multiple choices for prevention are available, and the best answer may be to apply several steps simultaneously. For *E. coli* O157:H7 infections related to the cattle reservoir, pasteurizing milk and cooking meat thoroughly provide an important measure of protection but are insufficient by themselves. Options for better control include continued improvements in slaughter plant hygiene and control measures under HACCP, developing additives to cattle feed that alter the microbial growth either in the feed or in the bovine rumen to make cows less hospitable hosts for *E. coli* O157, immunizing or otherwise protecting the cows so that they do not become infected in the first place, and irradiating beef after slaughter. For *C. jejuni* infections related to the poultry reservoir, future control options may include modification of the slaughter process to reduce contamination of chicken carcasses by bile or by water baths, freezing chicken carcasses to reduce *Campylobacter* counts, chlorinating the water that chickens drink to prevent them from getting infected, vaccinating chickens, and irradiating poultry carcasses after slaughter.

Outbreaks are often fertile sources of new research questions. Translating these questions into research agendas is an important part of the overall prevention effort. Applied research is needed to improve strategies of subtyping and surveillance. Veterinary and agricultural research on the farm is needed to answer the questions about whether and how a pathogen such as *E. coli* O157:H7 persists in the bovine reservoir, to establish the size and dynamics of a reservoir for this organism in wild deer, and to look at potential routes of contamination connecting animal manure and lettuce fields. More research is needed regarding foods defined as sources in large outbreaks to develop better control strategies and better barriers to contamination and microbial growth and to understand the behavior of new pathogens in specific foods. Research is also needed to improve the diagnosis, clinical management, and treatment of severe foodborne infections and to improve our understanding of the pathogenesis of new and emerging pathogens. To assess and evaluate potential prevention strategies, applied research is needed into the costs and potential benefits of each or of combinations.

To prepare for the 21st century, we will enhance our public health food safety infrastructure by adding new surveillance and subtyping strategies and strengthening the ability of public health practitioners to investigate and respond quickly. We need to encourage the prudent use of antibiotics in animal and human medicine to limit antimicrobial resistance. We need to continue basic and applied research into the microbes that cause foodborne disease and into the mechanisms by which they contaminate our foods and cause outbreaks and sporadic cases. Better understanding of foodborne pathogens is the foundation for new approaches to disease prevention and control.

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BECOMING ELECTRONIC: TAKE ME TO YOUR E-MAIL

Douglas A. Powell[1] and Linda J. Harris[2]

"I'll send ya an E-mail; what's your address?"

"Your business card doesn't seem to have an E-mail, or even a web page."

"Really? How old are you?"

If these questions routinely haunt your conference itinerary, then perhaps an introduction to electronic mail, or E-mail, is in order.

E-mail is one of many services available through the Internet or other commercial electronic information providers. To many, though, E-mail and the Internet are synonymous – the Internet being that vast array of local networks connected to two other networks, which are connected to two other networks, and so on; a worldwide network of computer networks. The Internet is the actual hard wire connecting computers around the world. It provides a number of services including E-mail, the World Wide Web (WWW), indexes, search engines, and mailing lists, among others.

The Internet began as a testbed system to meet defense research needs, funded by the U.S. Defense Advanced Research Projects Agency (DARPA) in the late 1960s. In 1986, the nonmilitary part of the system was handed over to other U.S. agencies, and eventually commercialized.

While researchers in universities and industry have been spoiled and have had Internet access for several years, high-access costs have kept many others from joining the party. For most individuals though, the primary reasons to hook up to the Internet are electronic mail, the World Wide Web, and mailing lists and newsgroups – electronically-mediated gab sessions where like-minded people can discuss the Unix operating system, nuances of the Canadian Constitution, home-brewing, and even food safety.

The most important questions individuals should ask themselves before they sign up to the Internet are, will I use it and how? Is it going to be beneficial to me? Just because everyone else is doing it doesn't mean you should, too. But once you start using the Internet, you may find it hard to believe that you ever managed without it.

The WWW is accessed using the Internet and could eventually provide the utopic concept of a universal database of knowledge. A software interface called a browser is needed to view the WWW. If your service provider is in your local telephone area, no matter where in the world your communications are going to, or coming from, all of the on-line phone time is at local call rates.

To have access to E-mail requires a computer with the ability to access a server and E-mail software. E-mail software is usually part of the package provided by Internet service providers. Many libraries, universities, research institutions, government agencies, and commercial organizations act as "servers." In addition, there are thousands of local Internet service providers (ISPs) in communities throughout North America, that provide at-home monthly Internet access via a computer modem for about $20 for a set number of hours, usually about five. Long distance charges may apply if the service provider is not located within the local phone area. There are also several commercial electronic information providers which offer Internet access and E-mail as part of their basic packages. For example, CompuServe (800.848.8990) charges about $10.00 (U.S.) per month and has by far the most extensive research databases and other information services, which are available at a surcharged rate, often about $0.25 per minute, or $1 to 2 per retrieved article. America On-Line (800.827.6364) is avail-

able at a monthly rate of about $10.00 (U.S.) and provides five hours of free access to whatever is available, including hundreds of newspapers and magazines.

Politicians and technology gurus are quick to note that the Internet and electronic infrastructure will fuel the new economy. But it is individuals who are driving the massive and consistent growth in Internet networks, hosts, users, traffic, and information. It is changing institutions, professions, and most importantly, people. Individuals.

This is the first in a series of articles written by members of the Food Safety Network Professional Development Group (PDG). The mission of the group is to provide IAMFES members with information on computer-based tools useful for protecting the food supply. For information on how to become a member of the Food Safety Network PDG, contact Linda Harris via E-mail at ljharris@ucdavis.edu.

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E-MAIL ADDRESSES:

Included with your Internet access will be a personal E-mail address from which you can send and receive messages.

E-mail addresses are in the following form:

username@host.subdomain.first level domain

e.g., jdoe@afns.ualberta.ca

username = jdoe = John Doe

host = afns = Animal Food and Nutrition Science Department

subdomain = ualberta = University of Alberta

first level domain = ca = Canada

An E-mail address is analogous to a mailing address where the host is the local street address, the subdomain is the city, and the first level domain is the state or province.

First-level domains in most countries are the country identification.

.ca = Canada

.fr = France

First-level domains in the U.S. describe the server institution:

.edu = education

.mil = military

.gov = non-military government

.com = commercial

.net = network

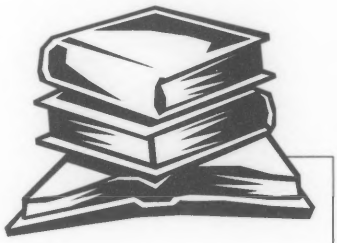
.org = organizations

E-mail attachments allow you to attach files to E-mail messages (although some difficulties may arise when exchanging between Macintosh and PC formats). Files can include documents, spreadsheets, graphics, photos, audio, and video.

Dairy, Food and Environmental Sanitation, Vol. 17, No. 12, Page 798

Book reviewed by: Jane A. Love, Associate Professor, Iowa State University, Ames, IA

Book Review



Flavorings in Food

The forty-eight report of the Steering Group on Chemical Aspects of Food Surveillance

Ministry of Agriculture, Fisheries and Food, United Kingdom

This report presents the results of two surveys on the use of flavorings in food in the UK. The surveys were conducted between 1984 and 1991 by the Ministry of Agriculture, Fisheries and Food and with the assistance of the UK flavoring industry. Before the surveys are described, background information on categories of flavorings is presented and the preparation of natural flavorings is described. An overview of legislative control of flavorings in food in several countries follows, with a separate section on legislative control in the UK and EC. The efforts of several international organizations in evaluation of flavorings are described and the activity since 1965 of several UK independent review committees is reviewed.

The report then describes the methods used in and results obtained from surveys in the UK about (1) the production and use of artificial flavorings and (2) natural flavoring source materials and preparations. The questionnaires used in the surveys, as well as lists of companies which participated, are provided in appendices to the report. Tables of information about the artificial flavorings substances and the natural flavoring source materials and preparations reported to be most widely used in the UK are included in the report; additional information from the survey is provided in the appendices. A project conducted between 1993 and 1994 to provide information on concentrations of certain biologically active principles in flavorings also is described. Tables giving the concentrations of pulgeone, coumarin, safrole and isosafrole, together with myristicin and menthol, in various flavoring source materials and preparations are included in the report. The text of the report contains 72 references to published literature on the regulation or technological aspects of food flavorings.

Readers with a broad interest in the development of regulations for food additives may find this report valuable. Those interested in concentrations of biologically active principles in plant materials that are used as sources for flavoring materials are also likely to find this report of interest.

For copies of *Flavorings in Food*–

Mail requests to: HMSO Publications Centre, P.O. Box 276, London SW8 5DT; Phone: 0171 873 9090; Fax: 0171 873 8200

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UpDates

Olewnik Named VP of Cereal Product R&D at AIB

Maureen Olewnik, who began work at the American Institute of Baking as a graduate assistant in 1982, has been promoted to Vice President, Cereal Product Research and Development, said Dr. Virgil Smail, AIB President.

Olewnik will direct a department with a new look. Her responsibilities will focus specifically on cereal and baked product research, seminars on pertinent technical topics, and technical assistance to the baking and allied industries. A new department to investigate and share information about new and emerging equipment and processing technologies for the industry is also being developed.

Olewnik has been involved in ingredient testing and flour quality evaluation at AIB for 14 years. Her work has included studies of both hard and soft wheat flours and their baking potential, as well as the impact of their biochemical components including starch, protein, lipid and enzymatic properties on processing and finished quality characteristics of bakery products. She is now working on the impact of environment and genetics and their interaction on wheat flour quality. The project will include use of near infrared technology in modeling bake quality performance characteristics. The study is evaluating environmental conditions during growing, milling quality characteristics, and baking potential. Olewnik is currently pursuing her doctorate from the Department of Grain Science and Industry from Kansas State University where she received her BS in 1979 and her MS in 1983.

At AIB, Olewnik has worked as a Cereal Chemist, Project Leader, and Experimental Bakery Manager. At the time of her promotion she was Director, Experimental Baking. She is a member of the American Association of Cereal Chemists since 1983 and has held several leadership positions in that organization. She is also a member of AOAC and the Hard Winter Wheat Quality Council, and has also published extensively in technical publications.

Flavorite Laboratories, Inc. Names Terry Johnson Director of Marketing

Flavorite Laboratories, Inc. is pleased to announce the promotion of Terry Johnson to Director of Marketing. Johnson's goal will be to spearhead Flavorite's marketing efforts to a new level by focusing on the company's newly adopted strategic long range business plan.

Johnson's experience has been in financial and marketing analysis, and since joining Flavorite in 1993, he has managed areas in sales administration, customer service and pricing. In addition to these areas, Johnson will now have direct responsibility for marketing.

Johnson received his BBA in Finance from Memphis State University in 1980.

Cornick Named Vice President, Marketing

Videojet Systems International, Inc. has announced the promotion of Bob Cornick to the position of Vice President, Marketing.

Mr. Cornick joined Videojet 2 years ago in the position of Director of Marketing, and has provided outstanding strategic direction and marketing insight during that period. An 18 year professional career in marketing and business development, Mr. Cornick has applied his considerable experience to directing Videojet's aggressive growth plan and business development activities.

Most recently, Mr. Cornick was a key player at Videojet's technologically advanced laser products offerings to the marketplace. His focus on customer needs and market intelligence has ensured that Videojet's commitment to superb customer care remains the central focus of the company worldwide.

New Internal Position, Reorganization at G&H

Jason Kerkman and Amy Mohr of G&H Products Corp. have recently accepted new positions.

Kerkman, formerly an Inside Sales Representative, has accepted a position as Technical Services Representative. In this role, Kerkman will provide customers with technical assistance on all products from G&H.

Mohr has assumed a new role as Project Coordinator. Formerly a member of the technical services department, Mohr is now responsible for working with the G&H sales force and customers to define project requirements and prepare project proposals. She will also coordinate all purchasing and assembly to meet customer deliveries and will serve as an after-sale Customer Liaison.

Competitive Inhibition May Enhance Safety of Minimally Processed Fruits and Vegetables

Lactic acid bacteria (LAB) may improve the safety of minimally processed (MPR) fruits and vegetables by inhibiting the growth of pathogens, according to a recent article in *Food Technology*.

Called competitive inhibition, this biocontrol approach uses nonpathogenic microorganisms to prevent the growth of pathogens in targeted substances. For example, LAB cultures may be applied to MPR fruits and vegetables (e.g., already peeled, and possibly sliced, grated, or shredded) to inhibit the growth of pathogens that may be present, including *Salmonella, Shigella, Escherichia coli* O157:H7, *Staphylococcus aureus,* and others.

"Whether these pathogens grow and cause disease depends on the type of product, conditions of storage (time, temperature, atmosphere, etc.), and competing microflora," stated Fred Breidt, Ph.D., and Henry P. Fleming, Ph.D. "Altering the normal microbial ecology of these products through cutting, processing, modified-atmosphere packaging, and refrigerated storage may have the unintended effect of allowing the growth of pathogenic bacteria [without biocontrol]."

Naturally found in fermented foods such as pickles and sauerkraut, lactic acid bacteria can prevent the growth of pathogens and spoilage organisms in minimally processed produce and other nonfermented foods. In fermented foods, these cultures are being studied for ways to manipulate the fermentation process to enhance flavor and shelf life.

LAB, such as the *Lactobacillus* species found in yogurt, are generally much more resistant to acid than other bacteria, thus can survive in environments that are lethal to most pathogens. Moreover, they can produce a variety of metabolites [substances produced by or taking part in metabolism], including lactic and acetic acids which increase acidity in foods, inhibiting the growth of other microorganisms.

Inhibitory metabolites produced by lactic acid bacteria include organic acids, hydrogen peroxide, enzymes, and bacteriocins. They are produced during the LAB metabolism of sugar (sucrose, fructose, or glucose) naturally found in or added to foods. The type of metabolite produced depends on the type of LAB in foods and their metabolic response to them.

"Biocontrol cultures will likely be product specific, as growth of bacteria in plant materials may be affected by the availability of nutrients and naturally present inhibitors," Breidt and Fleming wrote.

Washing procedures, including the addition of chlorine or other compounds to the wash water, generally have not been successful in reducing microorganisms on minimally processed fruits and vegetables, the authors noted.

"The ineffectiveness of washing or sanitizers to remove bacteria from produce is likely due to microorganisms located in protected regions near the surface of the plant material," Breidt and Fleming wrote.

Studies with endive leaves and salad products have shown that lactic acid bacteria can prevent the growth of pathogens like *Listeria monocytogenes, Salmonella typhimurium,* and *S. aureus.* Therefore, products for salad bars and fresh-cut, pre-packaged salads sold at retail may be good applications for these cultures. Competitive inhibition with LAB also shows great potential for enhancing the safety of fresh fruits and vegetables.

However, Breidt and Fleming noted that the use of protective cultures should only supplement good manufacturing practices, not substitute for the proper handling and packaging of produce.

A current application of competitive inhibition is the "Wisconsin process" for ensuring the safety of bacon. This process uses LAB cultures with reduced levels of nitrite to prevent the growth of harmful microorganisms.

Biocontrol has also been studied for use in poultry to reduce the presence of *Campylobacter jejuni,* in cattle to eliminate *E. coli* O157:H7 prior to slaughtering, and in refrigerated meat products to guard against spoilage.

Clark Recipient of Distinguished Alumnus Award

Dr. Warren S. Clark, Jr. CEO, American Dairy Products Institute, has been awarded the University of Connecticut Distinguished Alumnus Award for 1997. The award was presented at the University of Connecticut, Storrs, by University Chancellor, Dr. Mark Emmert, Dr. Kirklyn M. Kerr, Dean and Director, College of Agriculture and Natural Resources, and Mr. Herman R. Weingart, UCANR Alumni Association President.

Clark received his B.S. degree with honors in agriculture and distinction in dairy manufacturing from the University of Connecticut in 1956. Following military service he received M.S. and Ph.D. degrees from Iowa State University, major-

ing in Dairy Microbiology, with minors in biochemistry and human nutrition. Dr. Clark served as an Assistant Professor at Iowa State University for several years following which he began his association career in 1967 with the American Dry Milk Institute.

Ryan Instruments Becomes ISO 9001 Registered

Ryan Instruments has received from Raad voor Accreditatie and TUV Rheinland of North America, Inc., its registration as an ISO 9001 company.

The 9001 certification indicates that Ryan Instruments has conformed to the most complete ISO standard. This standard specifies key requirements for documented quality management systems and the effective implementation of such systems for design, production, inspection, test, installation, and service.

Ryan Instruments ISO 9001 success is a direct result of its strong commitment to quality. It enables Ryan to demonstrate that its products are manufactured and supplied to a guaranteed high standard.

Maryland Hospitality Education Foundation Announces Pilot Program for Regulating Food Safety

The Maryland Hospitality Education Foundation (MHEF), a division of the Restaurant Association of Maryland (RAM), has launched a first-in-the-nation initiative to address the public's concern about food safety– The Maryland Council on Food Safety, announced Jan Pundzak, MHEF Board President. MHEF's effort is a comprehensive plan that unites governmental agencies and food service operators in all establishments and institutions by providing one source for training, support, education, and certification.

The program, which is being observed as a pilot for the rest of the country, features The Seal of Commitment, a designation that can be displayed by participating establishments to the dining public. The Seal signifies completion of food safety courses by front-of and back-of-house staff end a continued compliance with the Council's mission.

The Maryland Council on Food Safety identified limitations within the current food safety training system: there was no single recognized statewide information source for industry professionals, governmental agencies or the public on food safety; certification training, the current standard of instruction, varied greatly in quality and was not structured for an entire staff or 'new hires'; and, an establishment's systematic commitment to food safety was not easily identifiable.

The Maryland Council has created many new services that will be implemented through MHEF, resulting in higher standards and increased benefits for operators. Among these: training for both front- and back-of house staff; new hire food safety training; two- and four-hour on-site food safety seminars; inspection violation prevention services; HACCP plan services; food safety manual services; menu nutritional analysis services; workplace safety training and risk management seminars; food allergy training; crisis management services; new product review resource guide; and Internet-accessible communication tools for regulatory agencies, industry professionals and the dining public.

The Seal of Commitment can be earned in jurisdictions where Sanitation Certification is mandatory (Montgomery, Prince Georges and Howard Counties and Baltimore City) by a Manager's Sanitation Certification (ServSafe) through MHEF and an on-site food safety seminar for the entire staff provided by an MHEF instructor. In jurisdictions where Sanitation Certification is not mandatory, the Seal is earned by an on-site food safety seminar for the entire staff provided by an MHEF instructor.

New England Dairy Finds Ways to Enhance Milk

Food scientists have known for decades that light can damage milk's flavor and nutrients. Translucent plastic bottles, which are widely favored by consumers because of convenience and account for more than 85 percent of all milk sales, provide little protection against light damage. According to a study on the PRNewswire, HP Hood, a New England dairy, is the first in the region to offer milk in an opaque, plastic LightBlock Bottle that protects both flavor and nutrients. Also, all Hood milk is now fortified with a significant level of vitamin C – an eight-ounce glass provides 25 percent of the recommended daily intake. Hood Vice President of Research & Development Don Erickson was quoted as comparing producing milk to developing a great tasting wine. "Milk, like wine, has to be handled with care from start to finish," he explained. Sidney Barnard, retired Professor of Food Science at Pennsylvania State University was quoted as saying "When exposed to even 20 minutes of sunlight, milk in translucent plastic containers begins to develop a tallowy, woody or oxidized taste. In some studies, half or more of the milk samples had pronounced light-induced flavors

when sampled within 36 hours of purchase, and three out of four consumers found these off flavors objectionable." The damage goes far beyond poor flavor, said Professor David Bandler of Cornell University, Food Science Extension. "Light exposure destroys many nutrients, including vitamins A, C, and B2 (riboflavin). Nutritional losses due to light may be severe. For example, up to 50 percent of some vitamins may be lost after 24 hours of exposure to fluorescent light."

Minor Uses/Minor Species Draft Guidance Published

The Food and Drug Administration has published draft guidance entitled "Guidance for Industry – FDA Approval of Animal Drugs for Minor Uses and Minor Species." This guidance document (number 61), when finalized, will supersede Guideline 26, "Guidelines for the Preparation of Data to Satisfy the Requirements of Section 512 of the Act Regarding Minor Use of Animal Drugs." This guidance document is being distributed for comment purposes only.

The major purpose of this document is to suggest means of generating effectiveness and safety data to support the approval of minor use animal drugs. A minor animal drug use is defined as use in a minor species or use in any animal species for a condition that is rare or that occurs in limited geographic areas. Minor species are defined by exclusion, as any species other than major species. Major species are defined as cattle, swine, chickens, turkeys, horses, dogs, and cats. According to current regulations, sheep are a minor species except with respect to human food safety data collection requirements, for which sheep are considered major species. Other guidance addresses issues related to exotic and wildlife species.

Copies of this draft guidance document may be obtained from the on-line library at CVM's Internet Home page (http://www.cvm.fda.gov/) or by calling CVM's Communications Staff at 301.594.1755.

Comments and suggestions regarding this draft document should be submitted by December 29, 1997, to the Dockets Management Branch (HFA-305), Food and Drug Administration, 12420 Parklawn Drive, Room 1-23, Rockville, MD 20857. Questions on this document may be directed to Dr. Meg Oeller, FDA/Center for Veterinary Medicine, HFV-130,7500 Standish Place, Rockville, MD 20855, 301.594.1650.

WELCOME

Last month IAMFES participated in the World Wide Food Expo in Chicago, Illinois. While exhibiting we offered a drawing for a one-year membership with IAMFES. We are pleased to announce the following winners of the drawing:

Ing. Bonifacio Gomez, Sigma Alimentos Corporativo, S.A. De C.V., Garza Garcia, N.L., Mexico

Barbara Blakistone, National Food Processors Association, Washington, D.C.

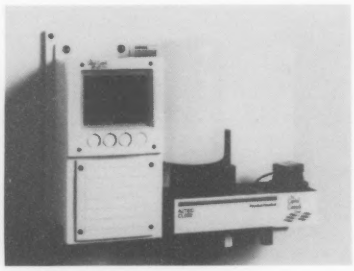
Tony Berry, C.A. Industrias Lara-Carabobo, Valencia, Venezuela

Leonard A. Ciani, FBC Industries, Schaumburg, Illinois

Mok Yuen Ching, King's Creameries (S) PTE Ltd., Jurong, Singapore

IAMFES hopes each of these new members find their membership rewarding.

IndustryProducts



Copitol Controls Company, Inc.

Capital Controls Company, Inc. Introduces New Residual Analyzer

The AZTEC® Series CL500 Residual Analyzer is designed to continuously monitor free or total chlorine or other oxidants in drinking water, wastewater, cooling water and other process water applications.

The microprocessor-based Series CL500 Residual Analyzer features a large, dot-matrix graphical display with a resolution up to 0.001 mg/l, on screen instruction, and automatic ranging to 20 mg/l. Six adjustable relays and dual 4 to 20 mAdc output signals are standard. The analyzer incorporates a constant, direct-drive electrode cleaning system which eliminates signal drift and the need for frequent recalibration.

The analyzer sample is gravity fed, eliminating the need for a sample pump. Reagents are added with a user-programmable solenoid valve to optimize the sample pH and reduce buffer consumption. Sample temperature variations are compensated with a 100 ohm RTD.

Capital Controls Company, Inc., Colmar, PA

Reader Service No. 336

VICAM Introduces Revolutionary Mini Fluorometer, MF-2000

Combining the distinct advantages of portability, versatility, and cost effectiveness, VICAM has introduced the MF-2000 Mini Fluorometer, an instrument for the detection of mycotoxins. The MF-2000 Mini Fluorometer offers the reliance of VICAM's proven affinity column chromatography with less capital investment in start-up equipment. The unit's portable test format affords users the coveted freedom of reliable testing wherever needed.

The MF-2000 is an accurate, fully functional, limited feature fluorometer capable of running all of VICAM's mycotoxin tests with quantitative or semi-quantitative results. Purposefully crafted to offer only essential features, the MF-2000 offers quantitation with a minimized initial capital outlay. Previously in the mycotoxin testing arena, there were only two major options: feature-rich, high priced fluorometry or subjective, low-cost screening technology. Now VICAM has introduced a very viable third option. By not incorporating features such as printing or data storage found in comprehensive fluorometry, the MF-2000 offers a 'nuts and bolts' approach to quantitative mycotoxin detection. Thus, for customers in need of a lower cost alternative to comprehensive fluorometry but desirous of more reliability and less subjectivity of a screening test, the MF-2000 is the perfect pick.

With the MF-2000, VICAM's affinity columns will be used in identical manner as they have been, except instead of placing the sample in the Series-4 for measurement, the sample is simply placed in the MF-2000. The display contains a row of lights with a test-specific template which serves as an overlay. The unit will take the measurement, and display a result by the light corresponding to the number on the template.

The MF-2000 is currently available for sale. "We are very excited to be able to offer this new unit in time for the peanut and corn harvests" comments Ralph Powell, Director of Sales. "Many people we talk to would like to set up our mycotoxin tests, but can't justify the capital investment of the Series-4, when they only require a screen test. We can now offer a portable unit that still gives people the accuracy and ease of use they like, with much less investment in equipment."

Since 1985, VICAM has contributed to food safety by marketing rapid test kits for the detection of pathogens and agricultural toxins

in food, feed, and beverages. These contaminants are routinely monitored by the food industry to ensure food safety. VICAM products include AflaTest, Afla B, Afla M, AflaTip, DONtest, FumoniTest, OchraTest, and ZearalaTest for the detection of toxins. VICAM also markets tests for the detection of *Listeria*, *Listeria monocytogenes*, *Salmonella*, and *Salmonella enteritidis*.

VICAM, Watertown, MA

Reader Service No. 337

Portable Sludge Meter Provides Rapid Stability Readings

The new EZ-BOD Meter from Bioscience, Inc. is programmed to provide sludge stability readings under U.S. 503 regulations in as little as 5 minutes.

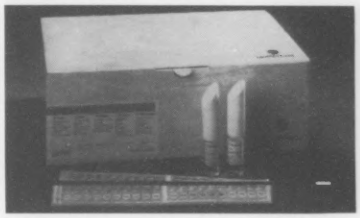
The 5-minute specific oxygen uptake rate (SOUR) program reports milligrams of oxygen per hour per gram of biomass to determine the stability of digested sludge for landfill or further processing.

The test is performed by placing a diluted sludge sample in the instrument's reactor bottle. An integrated, self-calibrating DO probe is then inserted and instructions for conducting the test appear on a liquid crystal display. The meter monitors DO as the test proceeds, automatically graphs and stores the data, calculates the test results and prints out a report.

The EZ-BOD Meter is preprogrammed to perform SOUR tests (U.S. 503 Sludge Regulations); one-hour biotreatability evaluations (ASTM Method 4478); quick BOD_5 estimation tests; and dissolved oxygen measurements. The size of a large briefcase, it can be used in the field with rechargeable batteries or as a benchtop instrument.

Bioscience, Inc., Bethlehem, PA

Reader Service No. 338



bioMérieux Vitek, Inc.

API® 20C AUX Test Kit Now Available Replaces API® 20C

API® 20C AUX is now available. This manual yeast identification test kit incorporates an easy-to-use inoculation medium that makes interpretation of positive and negative reactions simple. The kit provides species level identification within 24 to 72 hours depending upon the microorganism. It includes 25 test strips, report forms, 25 ampules of basal medium, incubation trays and lids. API 20C AUX is only one of more than 20 identification test kits available from bioMérieux Vitek–the largest in the industry.

bioMérieux Vitek, Inc., Hazelwood, MO

Reader Service No. 339

Raytek Introduces the Raynger® ST™ 3 for Food

Raytek is proud to introduce the latest addition to its portable series of infrared thermometers, the Raynger ST3.

This compact unit features high resolution and accuracy, with dual temperature display and a subzero temperature measurement range of -32 to 400°C (-25 to 750°F) as standard features. New technology includes tenth degree resolution for precise measurement of cooked or frozen foods, and temperature accuracy is 1% of the reading – that's twice the level of accuracy previously available.

For foodservice professionals this is great news. Monitoring food temperature is critical to ensuring food safety and quality. When food safety is the issue, the ST will help eliminate the risk of bacteria growth caused by unacceptable temperature ranges. To avoid the temperature "danger zone" store food below 4.4°C (40°F) and heat above 60°C (140°F).

Additional applications include monitoring the operation of foodservice and storage equipment, HVAC/R systems, electrical panels, electric motors and compressors, and any application where temperature is a consideration.

The large backlit display is easy to read and laser sighting adds pinpoint accuracy, especially in dim light conditions. A protective hard case is included with every unit.

Raytek Corporation, Santa Cruz, CA

Reader Service No. 340

New Family of Laser Coding Equipment to be Introduced

Videojet Systems International, Inc., manufacturer of industrial and graphic imaging systems, has announced its new "family" of laser coding products. Included in this offering will be CO_2 dot-matrix, "on-the-fly" beam-steered CO_2 and Nd:YAG laser systems, which will meet a myriad of laser coding application requirements. Videojet's control over the design and manufacture of laser coding products allows the company to apply its knowledge of the coding business to the development of truly unique solutions to real-world coding challenges.

The dot matrix laser product will incorporate features such as a flexible umbilical, two power level options, multiple language interfaces, and high speed high resolution laser coding, to provide

permanent, legible codes and markings on almost any packaging material or industrial substrate. Options include character width adjustment, sequential numbering, choices in date and time formats, incorporation of logos, and an RS-232 communication port. With no moving parts to wear out and a 20,000/hour tube, this CO_2 laser technology product will provide high reliability and low maintenance.

The "on-the-fly" beam-steered product can apply variable information on products moving through production lines or standing still. The unit itself is compact, and is air cooled, so that no add-on cooler is required. The operator interface incorporates a Windows™-based operating system, making it extremely user-friendly. This equipment can apply alphanumerics, graphics, and bar codes to a myriad of products.

Videojet Systems International, Inc., Wood Dale, IL

Reader Service No. 341

New HPC Test

The new IDEXX SimPlate™ for HPC is an easy-to-perform, easy-to-read heterotrophic plate count test. It can save valuable time and labor costs by eliminating autoclaving, media preparation, and the other time-consuming steps involved with current pour plate methods. To perform SimPlate for HPC, just place sample and prepared media into a SimPlate, and incubate 48 hours. To read the test, simply count the number of fluorescent wells and refer to the MPN chart to determine total counts. Tedious colony counting is not required.

IDEXX Laboratories, Inc., Westbrook, ME

Reader Service No. 342

Dynabeads® Immuno-Magnetic Separation (IMS) of Foodborne Pathogens

Dynabeads® anti-E. coli O157, Dynabeads® anti-Salmonella, and Dynabeads® anti-Listeria are designed for rapid, immuno-magnetic selective enrichment of microorganisms directly from pre-enrichment broths. The rapid and simple protocol (less than 1 hour) saves 24 hours of valuable testing time compared to culture methods using conventional selective enrichment media. Isolated colonies are achieved in 24 hours for *E. coli* O157 and 48 hours for *Salmonella* and *Listeria*. A method for EHEC isolation which utilizes Dynabeads® anti-*E. coli* O157 appears in the 8th edition of the Bacteriological Analytical Manual (BAM) and also is a Health Canada HPB Lab Procedure. Dynabeads® anti-Salmonella has achieved AOAC Performance Testing Status.

Dynabeads® are uniform, superparamagnetic microspheres (2.8 microns in diameter) with affinity purified antibodies on their surface. When incubated with a sample, Dynabeads® will bind their target bacterium forming a bacterium: magnetic bead complex. This complex is separated from the heterogeneous sample by performing the test in a magnetic test tube rack (Dynal MPC® -M). The isolated and concentrated bacterium: bead complex can then be cultured on any selective culture medium or used in other detection systems.

Dynabeads® IMS is a rapid culture technique – colony acquisition means rapid results with culture confirmation. This highly sensitive system will detect as few as 100 organisms/ml of pre-enriched sample. Improved bacterial isolation with this method also makes it useful for the culture confirmation of other presumptive methods.

Protocols are simple and reagents are shelf stable. The versatility provided by this methodology will allow testing of many different sample types while enhancing the efficiency of existing manual and automated detection methods.

Dynal, Inc., Lake Success, NY

Reader Service No. 343

BusinessExchange

Services/Products

ADVERTISING INDEX

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INTERNATIONAL ASSOCIATION OF MILK, FOOD AND ENVIRONMENTAL SANITARIANS, INC.

GENERAL FUND STATEMENT OF ACTIVITY FOR THE YEAR ENDED AUGUST 31, 1997

		% of Revenue
REVENUE:		
Advertising	$ 126,974	11.17%
Membership	311,122	27.37%
Communication	464,297	40.85%
Administrative	24,063	2.12%
Annual Meeting	206,583	18.17%
Workshops	3,650	0.32%
Total Revenue	1,136,689	100.00%
EXPENSES:		
Salaries and Benefits	356,074	31.33%
Building Operations	42,242	3.72%
Office Operations	88,639	7.80%
Professional Services	35,091	3.09%
Publications	397,572	34.98%
Travel	4,275	0.38%
Executive Board	17,341	1.53%
General Committee	1,610	0.14%
Annual Meeting	154,857	13.62%
Workshops	4,446	0.39%
Total Expenses	1,102,147	96.96%
Change in General Fund Assets	34,542	3.04%
General Fund as of 9/1/96	(82,468)	
General Fund as of 8/31/97	$ (47,926)	

ComingEvents

JANUARY 1998

·**5-9, Ice Cream Makers' Short Course,** Madison, WI. Offered by the University of Wisconsin-Madison. This 5-day short course is for those involved in or interested in the manufacture of frozen desserts or frozen novelties. Program Coordinator: Dr. Bob Bradley, 608.263.2007. For additional information, contact the Program Coordinators or Dept. of Food Science, University of Wisconsin-Madison, Phone: 608.262.3046 or Fax: 608.262.6872.

·**12-15, Milk Pasteurization and Process Control School,** Madison, WI. Offered by the University of Wisconsin-Madison. This 4-day short course provides in-depth training for those dairy industry personnel involved with thermal processing of milk and milk programs. Program Coordinator: Dr. Bob Bradley, 608.263.2007. For additional information, contact the Program Coordinator or Dept. of Food Science, University of Wisconsin-Madison, Phone: 608.262.3046 or Fax: 608.262.6872.

·**19-21, ASI Food Safety Consultants Lead Auditor Training Seminar,** at the Holiday Inn Downtown-Riverfront, St. Louis, MO. Learn how to perform your own food safety GMP inspections. For more information, contact Vicki Bodrow, ASI Food Safety Consultants, Inc., 7625 Page Blvd., St. Louis, MO 63133; Phone: 800.477.0778.

·**27-28, Emerging Issues in Food Science, Nutrition and Technology,** sponsored by Southern California Chapter-Institute of Food Technologists. For more information, contact Mindy Reeves, Phone: 909.869.2200; Fax: 909.896.4454; E-mail: msreeves@csupomona.edu.

·**29, Feb. 2, INDPACK '98 International,** International Exhibition & Conference for the Packaging Industry, in Mumbai (Bombay), India. For further information, contact Dusseldorf Trade Shows, New York, 70 West 36th St., Suite 605, New York, NY 10018; Phone: 212.356.0400; Fax: 212.356.0404; Web site: http://www.dtsusa.com/dts/.

FEBRUARY

·**3-4, Key Principles of Food Microbiology,** Brunswick, NJ. This course will introduce the principles of food microbiology and how to apply them to solve practical food microbiological problems. Participants will become familiar with environmental factors that influence the growth of bacteria in foods, genera of bacteria commonly associated with foodborne disease, HACCP tools and concepts and rapids in food microbiology. For further information, contact Keith Wilson, Phone: 732.932.9271; Fax: 732.932.1187; E-mail: ocpe@aesop.rutgers.edu.

·**16-18, 24th Annual Technical Seminar,** at the Radisson Hotel in Gainesville, FL. The technical update is designed to cover new technology, microbial intervention strategies and regulatory concerns of the food industry. For more information, contact Mary O'Neal at ABC Research, 3437 S.W. 24th Ave., Gainesville, FL 32607; Phone: 352.372.0436; Fax: 352.378.6483; Web site: www.abcr.com.

·**19-20, Concentrated & Dried Milk and Whey Products,** San Francisco Airport Hilton, San Francisco, CA. Review and update on science and technology of concentrated milk and whey products. Topics include the latest information on manufacture, performance and marketing trends including food applications and specifications of concentrated dairy ingredients such as concentrated milks, nonfat dry milk, whole milk powders and concentrates. For more information, contact Phil Tong, Phone: 805.756.6102; E-mail: ptong@calpoly.edu.

MARCH

·**3-5, Milkfat as a Food Ingredient Course,** University of Wisconsin-Madison, Madison, WI. The course is intended for people manufacturing or using milkfat ingredients. It will provide a better understanding of milkfat's chemical and physical properties, and how to select milkfat-derived ingredients for best performance in foods. For program information, contact Kerry Kaylegian, Program Coordinator-CDR at Phone: 608.265.3086; E-mail: kaylegia@cdr.wisc.edu.

·**17-18, Basic Food Microbiology Seminar,** Holiday Inn–Portland Airport, Portland, OR. This course will introduce the participant to the fundamental characteristics of microorganisms, and relate the application of microbiology to foods, food safety, and sanitation. For further information, contact Jack Brook, Dept. of Food Science Technology, Mt. Hood Community College, 26000 S.E. Stark St., Gresham, OR 97030; Phone: 503.667.7473; E-mail: brookj@mhcc.cc.or.us.

·**23-27, PanAmerican Congress on Mastitis Control and Milk Quality,** Co-sponsored by IAMFES. Merida, Yucatan, Mexico. For more information contact: Dr. W. Nelson Philpot, P.O. Box 120, Homer, LA 71040, Phone: 318.927.2388; Fax: 318.927.3133.

APRIL

·**2-4, Introduction to Statistical Methods for Sensory Evaluation of Foods,** University of California-Davis, Davis, CA. This course introduces statistical analysis to the beginning sensory scientist with little

or no statistical background and demonstrates how to perform the tests and provides a solid basis of understanding for sensory analysis. To register call 800.752.0881; after November 1, 1997, call 530.757.8777. For program information, contact Michael O'Mahony, at 916.752.6389; E-mail: maomhony@ucdavis.edu.

·**15-16, The Food Industry: Pennsylvania's Opportunities for the New Millennium,** Eden Resort Inn and Conference Center, Lancaster, PA. Sponsored by Penn State Dept. of Food Science. Invited to attend are R&D food scientists and engineers, marketing and plant managers from food processing and manufacturing companies. For more information, contact Dr. Hassan Gourama, Food Science Dept., Penn State-Berks Campus, Phone: 610.396.6121; E-mail: hxg7@psu.edu.

·**20-21, Food Micro '98,** Holiday Inn Select in Old Town Alexandria, VA. The workshop will focus on methods of controlling microbial foodborne illness, with speakers to include experts from universities, government agencies, and the food industry in general. The workshop is presented by the National Food Processors Association (NFPA) and is sponsored by the Food Processors Institute (FPI). For registration information, call Eric A. Forste, Program Coordinator, Phone: 202.393.0890; E-mail: eforste@nfpa-food.org.

·**24-29, Conference for Food Protection,** Swissotel, Boston. To receive additional information, contact Leon Townsend, CFP Executive Secretary, 110 Tecumseh Trail, Frankfort, KY 40601; Phone or Fax: 502.695.0253; E-mail: leontown@dcr.net.

JULY

10-11, 18th International Workshop on Rapid Methods and Automation in Microbiology, at Kansas State University, Manhattan, KS. Hands-on experiments, demonstrations, lectures, colloquium, scientific poster sessions and competition will occur. For scientific content, contact: Daniel Y. C. Fung, Director; Phone: 785.532.5654; Fax: 785.532.5681; E-mail: dfung@oz.oznet.ksu.edu. For registration information, contact: Janice Nikkel, U.S. Phone: 800.432.8222; Outside the U.S. 785.532.5575; Fax: 785.532.5637; E-mail: ksucon@dce.ksu.edu.

AUGUST

·**16-19, IAMFES Annual Meeting,** in Nashville, Tennessee at the Renaissance Nashville Hotel. For registration information see your January issue of *DFES* or contact Julie Cattanach at Phone: 800.369.6337; 515.276.3344; Fax: 515.276.8655; E-mail: jcattanach@ iamfes.org.

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	Procedures to Implement the Hazard Analysis Critical Control Point System	6.00	12.00	
	*Pocket Guide to Dairy Sanitation (minimum order of 10)	.50	.75	
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International Association of Milk, Food and Environmental Sanitarians

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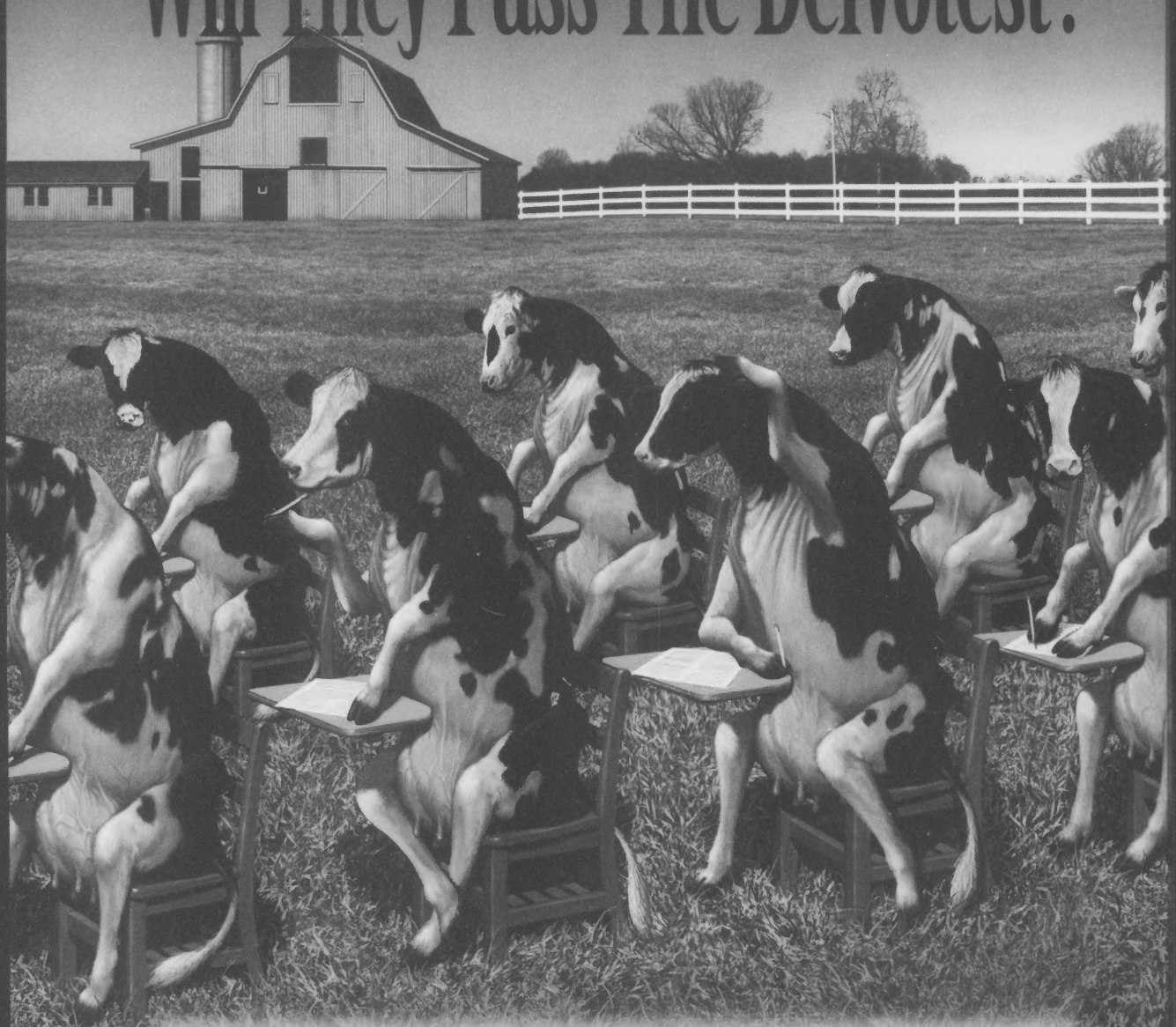

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